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LETTER OF TRANSMITTAL

TO: County of Humboldt
Division of Environmental Health
100 H Street, Suite 100
Eureka, California 95501

ATTN: Mr. Mark Verhey, C.E.G.

DATE: August 9, 2005
JOB NO.: 3577.02
PROJECT: Former Rio Dell Shell

TRANSMITTED BY: ☒ Mail ☐ Delivered In Person ☐ Fax

No. Copies		Description
1	1.	Remedial Action Plan
	2.	
	3.	
	4.	
	5.	

REMARKS:

THIS MATERIAL SENT FOR: ☒ As Requested ☒ Information
☐ Approval ☐

cc: Jim Seiler (electronically sent)

By: V.T. Sullivan
Vincent T. Sullivan, E.I.T.

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www.lacoassociates.us

REMEDIAL ACTION PLAN

Former Rio Dell Shell
481 Wildwood Avenue
Rio Dell, California

LOP NO. 12261

Prepared for:
Jim Seiler
Humboldt Petroleum, Incorporated
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August 9, 2005
Project No. 3577.02

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REMEDIAL ACTION PLAN

Former Rio Dell Shell

481 Wildwood Avenue, Rio Dell, California

LOP No. 12261; LACO ASSOCIATES Project No. 3577.02

EXECUTIVE SUMMARY

The site is located along Wildwood Avenue in Rio Dell, California (Figures 1 and 2). The responsible party is Humboldt Petroleum, Incorporated (HPI). LACO ASSOCIATES (LACO) was retained by the responsible party as an engineering consultant to perform professional services required by the Humboldt County Division of Environmental Health (HCDEH). In advance of this site's admission into the State of California's Pay-for-Performance (PFP) program, LACO has prepared the following remedial action plan (RAP) to address the details of implementation. The following RAP recommends an *in-situ* chemical oxidation (ISCO) system pilot test and installation of exploratory borings into the site's upper and lower water-bearing units.

INTRODUCTION

Historical subsurface investigations at the site have identified a dissolved-phase fuel oxygenate plume which extends approximately 80 feet downgradient from the site. LACO proposes installing, operating, and monitoring an ISCO sparging pilot system, in advance of a full-scale system, to remediate the off-site dissolved-phase hydrocarbon plume, specifically methyl tertiary butyl ether (MTBE). To delineate the vertical and lateral extent of gasoline-range hydrocarbons in groundwater, LACO proposes the installation of exploratory borings.

SCOPE OF WORK

LACO proposes the following scope of work:

- Install, operate, and monitor the effectiveness of a pilot test using an ISCO sparging system at the subject site (Figure 3). The purpose of the ISCO sparging system is to remediate the dissolved-phase gasoline-range hydrocarbon plume, primarily MTBE, which extends approximately 80 feet hydraulically downgradient from the site. To monitor the effectiveness

of the sparging system, LACO proposes the installation of one monitoring well northeast of the proposed treatment zone.

- To reduce the potential for vertical hydraulic gradients (and therefore cross-contamination) from the site's upper water-bearing unit into the higher conductivity lower water-bearing unit, LACO proposes to reconstruct monitoring well MW3.
- To close a data gap and to delineate the vertical and horizontal extent of gasoline-range hydrocarbons in groundwater, LACO proposes the installation of nine exploratory borings into the site's upper and lower water-bearing units during implementation of this RAP. Included in these nine borings are two hand-augered borings to be installed within the fill material of the utility trench adjacent to the site. These borings will be installed to investigate the trench's fill material for dissolved-phase hydrocarbon contamination, specifically MTBE, in advance of consideration for site closure.

A figure illustrating the proposed remedial system, exploratory borings, and monitoring well is included as Figure 3.

I. Remedial Action Plan – Air/Ozone Sparging Remedial System

A. Background

1. *Hydrogeology*

Stratigraphic data from previous boring and monitoring well installations have provided the information to draw conclusions about the hydrogeologic conditions on this site. Site geology generally consists of fill overlying silty clay with thin stringers of sand and fine gravel to a depth of approximately 10 feet below ground surface (bgs). A fat clay deposit was encountered at approximately 10 to 15 feet bgs, and is likely serving as a confining layer separating the perched water-bearing unit from the underlying deep water-bearing unit.

The hydraulic gradient of the shallow water-bearing unit has historically fluctuated between east-northeast (ENE) and southwest since gradient calculations were initiated in July 2001. Groundwater appears to be present in the shallow water-bearing unit year-round. The hydraulic

gradient of the deep water-bearing unit has generally flowed toward the ENE to southeast since March 2003, and groundwater also appears to be present in the deep water-bearing unit year-round.

The hydraulic gradient of the shallow water-bearing unit appears to be influenced by the proximity of the gravel-filled underground storage tank (UST) cavity. The UST cavity may be acting as a sump for the shallow aquifer, thereby influencing the hydraulic gradient of the shallow water-bearing unit. The relatively high hydraulic conductivity of the gravel-filled UST cavity, in comparison to the lower hydraulic conductivity of the silty clay surrounding the UST cavity, should readily draw groundwater that would otherwise flow through the silty clay. Based on the distribution of the dissolved-phase MTBE plume toward the northeast (Figure 4), the dominant hydraulic gradient of the shallow water-bearing unit appears to be toward the northeast.

2. *Contaminants of Concern (COCs)*

Total petroleum hydrocarbons as gasoline (TPHg), MTBE, tertiary amyl methyl ethane (TAME), tertiary butyl alcohol (TBA), and ethyl tertiary butyl ether (ETBE) are the primary COCs identified within the proposed treatment zone. During previous investigations, the maximum sorbed-phase total petroleum hydrocarbon (TPH) concentration encountered in the proposed treatment area was reported during the installation of monitoring well MW5 (400 µg/g, at 4 feet bgs). Dissolved COCs TPHg (1,300 µg/L), MTBE (2,200 µg/L), TBA (1,200 µg/L), and ETBE (8.6 µg/L) have been reported for groundwater samples collected from monitoring well MW7, and dissolved-phase TAME (88 µg/L) has been reported for groundwater samples collected from monitoring well MW8. Both monitoring well MW7 and MW8 are within the proposed treatment area. Historic soil laboratory analytical results and quarterly groundwater monitoring analytical results are included as Tables 1 and 2, respectively.

II. Remedial System

A. Description

The proposed remedial system is an ozone sparging system comprising a master panel and distribution network. The master panel comprises an ozone generator, oxygen-booster, positive displacement pump, control system, cooling system, outflow one-way check valve, and a high temperature shut-down switch. For the initial pilot test, a mobile remediation unit will be brought to the site. A junction box will be installed on-site where the mobile system will connect to the distribution network. Following the conclusion of the pilot test, a master panel will be installed on-site for the remainder of treatment.

The distribution network is comprised of double-contained $^{3}/_{8}$ -inch diameter tubing, a one-way check valve, ¾-inch diameter PVC riser, and a 2-inch diameter KTI® sparge point. The distribution lines will be laid in a trench network. The mobile remediation unit will cycle flow to each sparge well for a specified duration. The full scale distribution network will include an array of 9 to 12 sparge points which is further described in Section II.E "Treatment Array and Operation Model." The final number and location of sparge points will be evaluated after receipt of the proposed borings analytical results and at the conclusion of the pilot test. The pilot test will utilize three angled sparge wells to be located in the sidewalk on the northeastern side of the site. The bottom of the sparge points will be installed beneath the former northeastern pump island to a vertical depth of 6 feet bgs, at an angle of approximately 22 degrees from horizontal.

B. Theory

Ozone sparging combines the principles of air sparging with oxidative decomposition (Kerfoot and LeCheminant, 2002). When air is bubbled through interstitial spaces in a formation, volatile organic compounds (VOCs) transfer from liquid to gas phase. The small bubbles produced by the KTI® sparge points ensure the efficient transport of the bubbles throughout the formation, and minimize the likelihood of the gas forming flow channels. Additionally, the surface area to volume ratio of the bubbles maximizes VOC phase transfer and increases the ability of ozone to strip VOCs (Kerfoot and LeCheminant, 2002). The decomposition of MTBE produces hydrogen

peroxide, releasing hydroxyl radicals which further accelerate the process (Karpel vel Leitner, *et al.*, 1994). A secondary decomposition by-product of MTBE and a primary decomposition by-product of hydrogen peroxide is oxygen. This results in oxygen-enriched groundwater downgradient of the treatment area.

C. Remedial Model

The following discussion outlines the remedial process of the ozone sparging system. The majority of the secondary source to be treated is located onsite. Within the proposed treatment zone onsite, the sorbed-phase TPH mass is estimated to be approximately 5.75 kg. The mass calculations are included as Worksheet 1. The ozone mass discharge from the master panel is estimated to be 12 grams per hour (g/hr), for a system design with an ozone concentration of 1,100 ppmv (0.11 percent), a flow rate of 3 cfm, and an ozone density of 2.144 gm/L. The ozone demand for TPH is estimated to be between 15 percent and 20 percent of the contaminant mass. Approximately 80 hours of ozone injection is required to oxidize the estimated 5.75 kg of sorbed-phase TPH alone. This estimate is not including other subsurface demands which are discussed below.

When an oxidant is applied to a subsurface environment, several receptors compete for reaction. Some of these potential receptors include hydrocarbon contaminants, oxidizable metals, and other organics present in the soil. Kerfoot and LeCheminant (2002) detailed a process of calculating the ozone demand for a given system. This allows an estimation of the life span of the remedial system for a given mass of ozone injected. As this calculation does not take into account secondary MTBE decay products (hydroxyl radicals) or the indirect effect of increasing the oxygenation of the groundwater on the dissolved-phase contaminants, the life span estimate represents the maximum time needed to oxidize the potential receptors. A worksheet with the ozone demand calculations for this site is included as Worksheet 2.

Masses used in the computation of stoichiometric, soil oxygen, oxidizable metals, and other organics demands are included within Worksheet 2, along with each assumed ozone demand.

Assumptions used in the design of this remedial system are illustrated in Table A, included below.

Table A: Assumptions Incorporated in Remedial Sytem Design

Demand	Area ($feet^2$)	Depth (feet)	Average Concentration	Value	Ozone Demand (% of mass)	Ozone Demand (kg O_3)	Additional Comments
Treatment Zone Volume ($feet^3$)	2,889	4	---	11,556	---	---	---
Dissolved MTBE Mass (kg)	Area 1 - 175 Area 2 - 2,714	7	Area 1 - 100 µg/L Area 2 - 1,000	0.056	250	0.140	---
Sorbed-phase TPH Mass (kg)	Area 1 - 175 Area 2 - 2,714	4	Area 1 - 100 µg/g Area 2 - 1 µg/g	5.75	17.5	1.006	---
Dissolved-phase TPH Mass (kg)	Area 1 - 175 Area 2 - 2,714	7	Area 1 - 800 µg/L Area 2 - 100 µg/L	0.052	17.5	0.009	---
Dissolved-phase Oxygenates (kg)	2,889	7	100 µg/L	0.021	325	0.068	---
Dissolved Iron Mass (kg)	2,889	4	18000 µg/L	0.880	50	0.44	Average dissolved iron concentrations were not available for this site, but were obtained from a site with similar stratigraphic characteristics
TOC Mass (kg)	2,889	4	2132 µg/g	1,047	30	314	SOD is estimated as 30% of total organic carbon content (1,047 kg * 0.3 = 314 kg)

TOC = total organic carbon
SOD = soil oxygen demand

To determine a project life span, the mass of ozone discharged must be determined. The ozone mass discharge from the master panel with the oxygen booster is estimated to be 12 g/hr. With the estimated masses discussed above, the life span of this remediation is projected at approximately 3 years. This estimated remediation life span is based on the contaminant masses and ozone demands illustrated in Worksheet 2 and Table A. However, this calculation is based strictly on the effect of ozonation breakdown of the contaminant species. As stated above, the addition of hydroxyl radicals formed in the oxidation of MTBE and the increased oxygenation of the groundwater plume have not been included. Both of these serve to increase the rate of contaminant degradation and lessen project life span.

Remediation progress will be monitored by the treatment-array monitoring network described in Section III.A "Proposed Monitoring Network."

D. By-Products

Laboratory experiments indicate potential formation of tertiary butyl formate (TBF) and TBA as by-products of MTBE ozonation (Vel Leitner *et al*, 1994). As TBF is the primary reaction by-product, it will be monitored according to the regular sampling schedule. Carbon dioxide is the end product of the reaction and will be also be included in the monitoring program.

E. Treatment-Array and Operation Model

The treatment zone is defined as that area within the radius of influence (ROI) of the sparge wells. In order to maximize the ROI, and prevent shearing of the formation, development of the sparge well is recommended. Sparge well development is discussed in Section II.I "Sparge Well Development".

The radial distribution of gas from a sparge point is governed by the following:

1) Pore size - the size of the openings between grains is a limiting factor
2) Hydraulic pressure - the weight of the water column over the sparge point
3) Formation grain size distribution - the percentages of grain sizes
4) Gas flow rate - the most sensitive factor in radial distribution

Geophysical data, in the form of grain size analysis, is available from previous investigations at this site and will be used in maximizing the ROI of the remedial system.

The on-site sparge wells will be arrayed around known areas of dissolved-phase gasoline-range hydrocarbon contamination, particularly dissolved-phase MTBE contamination. The locations of the proposed sparge points are illustrated on Figure 3, and a figure illustrating the off-site extent of dissolved-phase MTBE is included as Figure 4. The ROI of the ozone bubbles will be partly determined by the depth of the groundwater in relation to the depth of the sparge point. A worksheet illustrating the ROI calculations based on hydraulic head and system pressures is included as Worksheet 3. The lowest depth-to-water (DTW) measurement observed in the on-site

wells is approximately 11.45 feet bgs. The bottom of the pilot sparge points will be set at approximately 15 feet bgs. Depth to the bottom of the remaining sparge points will be determined following receipt of the exploratory boring analytical results and initial pilot test observations.

A pilot start-up test will be performed for 5 days with a timed cycle to each pilot sparge well. The details of the pilot start-up test are described in the Section II.K "Pilot Test." Following analysis of monitoring data, a standard operational schedule for the pilot test will be designed and submitted to the HCDEH for review. The mobile ozone sparging unit will be used for the initial pilot test, which will run for a minimum of 6 months. The system will be monitored to determine the actual ROI of the pilot sparge wells and its effectiveness at remediating the COCs. If ozone proves to be successful for remediation of the on-site secondary source, a master panel will be installed on-site for the remainder of treatment.

F. Master Panel Installation

After completion of the pilot test, a master panel will be installed adjacent to the existing building. The master panel installation details will be included with the results of the pilot test to be submitted to the HCDEH for review.

G. Distribution Network Installation

The distribution lines ($^{7}/_{8}$-inch OD) for the proposed system will be comprised of double-contained tubing and will be directly buried and overlain by 6 inches of 2-sack sand slurry. Distribution line trenches will be approximately 12 inches deep and 15 inches wide. The top 6 inches of the trench will be backfilled with hot-mix asphalt. Location of the trench will be surveyed under the direction of a licensed surveyor. A map showing locations of the buried network and sparge wells will be posted inside the on-site building and on file at the HCDEH. A separate line will run from the master panel connection point to each sparge well. A licensed contractor will install and connect the distribution network.

H. Sparge Well Installation

The sparge wells will be installed using a direct push drill rig fitted with 3.25-inch diameter (OD) drive tubes or a rotary drill rig fitted with a 6 $^{5}/_{8}$-inch hollow stem auger. The sparge wells will be constructed with 30-inch long, 2-inch diameter Kerfoot Technologies (KTI®) micro-porous sparge point attached to ½ -inch Schedule 80 PVC pipe. The PVC pipe will be connected to a one-way check valve which will be connected to a quick connect 0.5 feet below grade. The annular space will be filled with No. 60 sand from the bottom of the bore hole to 1 foot above the sparge point, hydrated bentonite chips or cement grout to 3 feet bgs, and concrete to grade. A traffic-rated aluminum access box with a bolt-down watertight lid will be set in an apron of traffic-rated concrete extending at least 6 inches from the access box.

I. Sparge Well Development

Development of a sparge well consists of slowly increasing the flow until a pressure loss is reached that is expected for the soil type and depth. This is the formation loss. As fines are mobilized the formation loss will drop until the flow is increased. This routine is performed until a change in formation loss of less than 2 psi is observed over 30 minutes or the pre-determined pressure is reached. The remediation scientist will determine the formation loss expected for the soil type and depth.

J. Start-up Test

A start-up test will be performed following installation of the sparge wells, distribution network and master panel connection point. The start-up test will run for approximately 2 hours. During this time period the system will be checked for leaks. DTW measurements, dissolved oxygen (DO), and conductivity (ECw) measurements, and visual inspection for bubbles will be made in the treatment-array monitoring wells in the vicinity of the active sparge well. Data generated during the start-up test will be used to determine the sparge cycle for each well.

K. Pilot Test

The pilot test will run for a minimum of 6 months using a sparge cycle duration determined from the start-up test. DTW measurements, DO, and ECw measurements, and visual inspection for bubbles will be made once every week in the treatment-array monitoring wells. The duration of the sparge cycle will be modified based on the change in contaminant concentrations, groundwater depths, DO levels, and presence or absence of bubbles. Groundwater samples will be collected from the treatment-array monitoring wells bi-monthly and submitted to North Coast Laboratories (NCL), a state-certified laboratory, for analysis of TPHg, BTEX, MTBE, TAME, TBA, Di-isopropyl Ether (DIPE), and ETBE. In order to verify any potential by-products from the ozonation process, groundwater samples collected following the pilot test will also be analyzed for total carbon dioxide and TBF.

III. System Monitoring

A. Proposed Monitoring Network

In order to gain an appropriate amount of data to determine the effectiveness of the proposed treatment system, LACO recommends the installation of an additional monitoring well outside the treatment zone, with a screen to be determined after receipt of the analytical results of the boring installation. The proposed location of the monitoring well is presented on Figure 3, and details of the proposed monitoring well's installation are presented in the section entitled "Monitoring Well and Borings Installation, Monitoring Well Reconstruction", included below.

B. Proposed Monitoring

During the pilot test, groundwater samples will be collected from existing monitoring wells MW2 through MW10 and proposed monitoring well MW11. Samples will be submitted to NCL for analysis of TPHg, BTEX, five fuel oxygenates, carbon dioxide, and TBF. Field measurements of DO, ORP, pH, and temperature will also be collected. The post-pilot test monitoring schedule will be submitted with the results of the pilot test.

Procedures involved in implementation of this RAP are as outlined in the LACO Standard Operating Procedure No. 1 (SOP) included as Attachment 1. An updated HAZWOPER and medical surveillance list of LACO personnel in included as Attachment 2

IV. Monitoring Well and Borings Installation, Monitoring Well Reconstruction

A. Monitoring Well Installation

LACO presents this workplan to install a monitoring well for the purpose of monitoring the effectiveness of a pilot test using an ISCO sparging system at the subject site. The proposed monitoring well is to be installed at the location indicated on Figure 3. The screen interval of the proposed monitoring well will be determined once analytical results from the boring installations have been received.

The well will be installed with 3.25-inch diameter dual tube rods and direct push technology. An illustration of typical well construction details using direct push technology is included within LACO's SOP No. 1 as Figure 8. The monitoring well will be constructed with 1.5-inch diameter solid casing from the ground surface to the top of the screened interval, and 0.010-inch slotted screen from the base of the solid casing to the total depth of the well. The annular space will be filled with No. 2/16 sand from the base of the well to 1 foot above the screened interval. Hydrated bentonite chips will seal the well from one foot above the screened interval to approximately 1.5 feet below grade. Cement slurry will extend from the top of the bentonite to grade. An 8-inch traffic-rated "Christy box" with bolt-down watertight lid will be set in an apron of traffic-rated concrete extending at least 6 inches from the access box. The well will be completed with a locking well cap.

LACO will develop the monitoring well no less than 72 hours after installation. The first groundwater sampling will occur no less than 24 hours after well development. Groundwater samples will be collected from the monitoring well on a quarterly basis. The monitoring well's location and top of casing elevation will be surveyed according to Geotracker AB 2886

regulations. The monitoring well's top of casing elevation will be measured to 0.01 feet referenced to NAVD-88 under the supervision of a licensed surveyor.

B. Boring Installations

LACO presents this workplan for boring installations to delineate the vertical and lateral extent of gasoline-range hydrocarbons in groundwater. All work will be performed in accordance with LACO's SOP No. 1 (Attachment 1). All utilities in the vicinity will be located prior to drilling by the Underground Services Alert (USA). The City of Rio Dell (City) and the client will be notified a minimum of 48 hours prior to the initiation of work activities. The HCDEH will be notified 5 days in advance. LACO will obtain all necessary permits and access agreements.

Nine temporary borings will be installed to assess the extent of sorbed- and dissolved-phase MTBE contamination in the site's upper and lower water-bearing units (Figure 3).

Soil Borings, Upper Water-Bearing Unit

Because previous boring installations at this site have resulted in low to non-existent quantities of groundwater, LACO proposes the installation of two temporary direct-push soil borings to delineate the horizontal distribution of TPHg, MTBE, TAME, TBA, and ETBE. The temporary direct-push soil borings will be installed within the site's upper water-bearing unit, at intervals of 4 to 8 feet bgs, 8 to 12 feet bgs, and 12 to 16 feet bgs. Borings will be installed using direct push technology. Soil samples will be placed directly into laboratory-supplied containers, kept cold, and transported to NCL under standard chain-of-custody protocol.

Soil samples will be analyzed for:

- TPHg by EPA Method 8260B
- BTEX by EPA Method 8260B
- MTBE, TAME, TBA, ETBE, and DIPE by EPA Method 8260B

Additionally, soil samples will be collected for Percent Moisture (by weight) by ASTM D-2216. LACO will use the soil moisture data in conjunction with chemical analytical data to estimate the concentration of fuel oxygenates in soil-water. A conversion equation approximation is presented below. The tendency of fuel oxygenates to sorb to soil particles is extremely low. As such, any fuel oxygenates in the soil samples are assumed to be dissolved within the soil-water. The EPA 8260B analysis will provide a wet-weight result; therefore, the moisture content will be used to convert the result from analyte weight per gram of sample to analyte weight per gram of soil-water. The result is then multiplied by 1,000 to convert from analyte weight per gram of water to analyte weight per liter of water, assuming the density of water to be 1g/cc.

$$\frac{Analyte\ weight\ (\mu g)}{gram\ of\ sample} * 1\% * \frac{1{,}000\ g\ H_2O}{1\ L\ H_2O} = analyte\ concentration\left(\frac{\mu g}{L}\right)$$

Borings will be closed according to HCDEH requirements within 72 hours of installation. A report summarizing the findings of the boring installations will be submitted following receipt of laboratory analyticals. The locations of the proposed borings are included on Figure 3.

Lower Water-Bearing Unit Borings

Seven temporary borings will be installed using direct push technology with anticipated depths to approximately 30 to 40 feet bgs. Depth-discrete groundwater samples will be collected using direct push hydropunch technology and disposable tubing affixed with a check-ball valve. Groundwater samples will be decanted directly into laboratory-supplied containers, kept cold, and transported to NCL under standard chain-of-custody protocol for analysis of:

- TPHg by EPA Method 8260B
- BTEX by EPA Method 8260B
- MTBE, TAME, TBA, ETBE, and DIPE by EPA Method 8260B

Utility Trench Borings

To determine the potential impact of the dissolved-phase hydrocarbon plume on the utility trench located adjacent to the site, LACO proposes to install two hand-augered soil borings into the utility trench's fill material. These borings will be installed only if the HCDEH deems it neccesary to investigate the trench's fill material for dissolved-phase hydrocarbon contamination before site closure can be considered. Soil samples will be placed directly into laboratory-supplied containers, kept cold, and transported to NCL under standard chain-of-custody protocol.

Soil samples will be analyzed for:

- TPHg by EPA Method 8260B
- BTEX by EPA Method 8260B
- MTBE, TAME, TBA, ETBE, and DIPE by EPA Method 8260B

Soil samples will also be analyzed for percent moisture (by weight) by ASTM D-2216. As described above, LACO will use the soil moisture data in conjunction with chemical analytical data to determine the concentration of fuel oxygenates in soil-water.

Monitoring Well Reconstruction

To reduce the potential for vertical hydraulic gradients (and therefore cross-contamination) from the site's upper water-bearing unit into the higher conductivity lower water-bearing unit, LACO proposes to reconstruct monitoring well MW3. Monitoring well MW3 will be reconstructed with a screened interval installed solely in the lower water-bearing unit, which consists of sandy gravel and silty sand. In previous investigations at this site, sandy gravel and silty sand has been encountered below approximately 20 feet bgs.

The existing monitoring well will first be destroyed by overdrilling the installed monitoring well pipe and annular materials. Monitoring well MW3 will then be reconstructed using 2-inch diameter solid casing from the ground surface to the top of the screened interval, anticipated to be approximately 20 to 25 feet bgs, and 0.010-inch slotted screen from the base of the solid

casing to the total depth of the well. The annular space will be filled with number 2/16 sand from the base of the well to 1 foot above the screened interval. Hydrated bentonite chips will seal the well from one foot above the screened interval to approximately 1.5 feet below grade. Cement slurry will extend from the top of the bentonite to grade. An 8-inch traffic-rated "Christy box" with bolt-down watertight lid will be set in an apron of traffic-rated concrete extending at least 6 inches from the access box. The well will be completed with a locking well cap.

C. Proposed Monitoring

The proposed monitoring well will be incorporated into the monitoring schedule proposed in Section III.B, above.

V. Proposed Implementation Schedule

October 2005	:	RAP approval
December 2005	:	Installation of pilot sparge points, temporary borings, and monitoring well installation/reconstruction. Begin pilot test following start-up test.
May - August 2006	:	Design and approval of full-scale distribution network.
September 2006	:	Installation of full-scale distribution network.

REFERENCES

Kerfoot, W.B., and P. LeCheminant. 2002. Ozone microbubble sparging at a California site. In: E.E. Moyer and P.T. Kostecki (eds.) *Handbook for Managing Releases of Gasoline Containing MTBE.* Preprint Amherst Press, Amherst, MA.

Vel Leitner, N. Karpel; Papailhou, A.L.; Croue, J.P; Peyrot, J., and Dore, M., 1994. Oxidation of Methyl Tert Butyl Ether (MTBE) and Ethyl Tert Butyl Ether (ETBE), by Ozone and Combined Ozone/Hydrogen Peroxide. *Ozone Science and Engineering.* 16: 41-54.

LIST OF FIGURES, TABLES, WORKSHEETS, AND ATTACHMENTS

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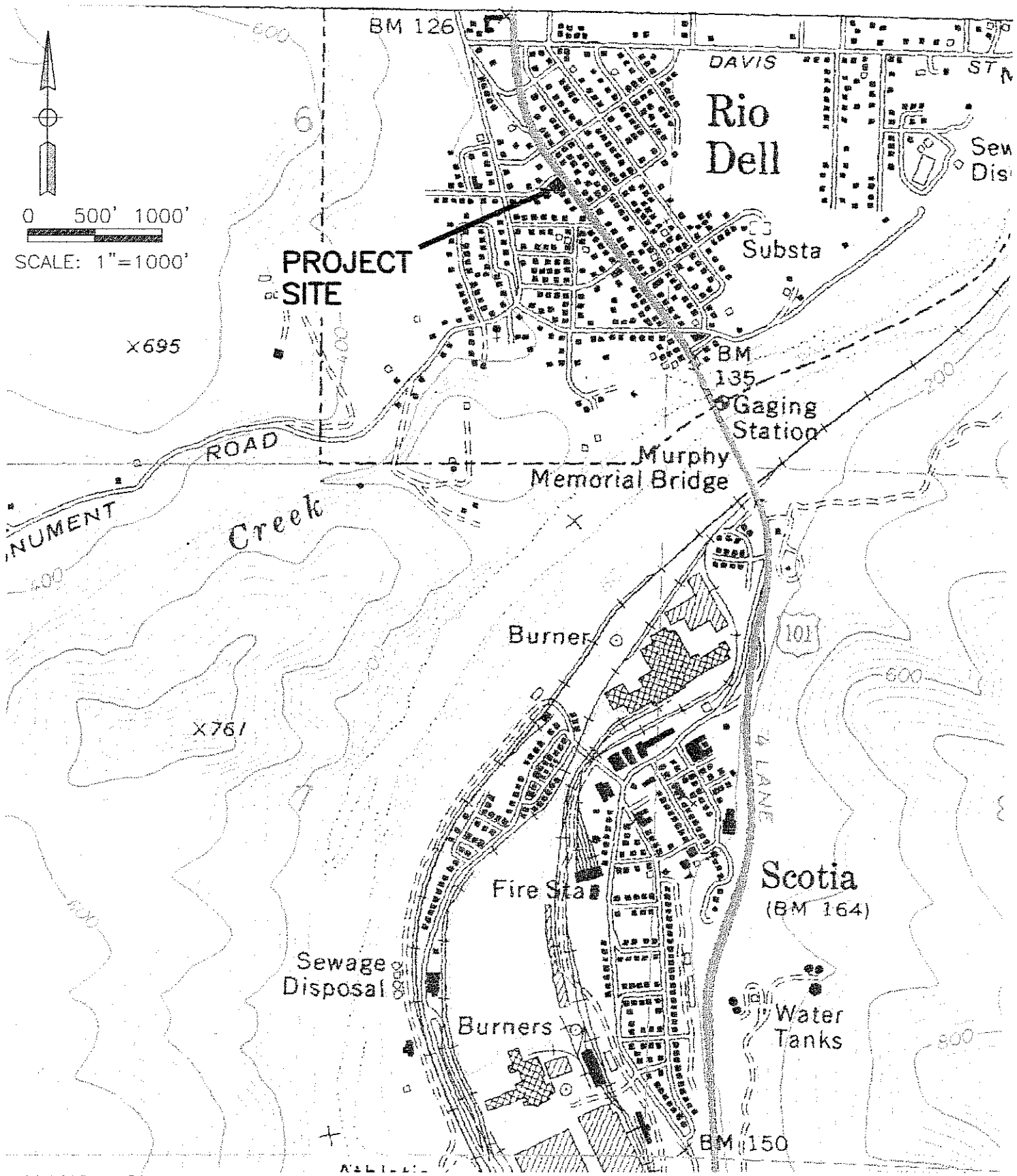
LACO ASSOCIATES CONSULTING ENGINEERS 21 W 4TH ST. EUREKA, CA 95501 (707)443-5054	PROJECT	REMEDIAL ACTION PLAN	BY RJM	FIGURE 1
	CLIENT	HUMBOLDT PETROLEUM INC.	DATE 6/22/05	
	LOCATION	481 WILDWOOD AVE, RIO DELL	CHECK	JOB NO. 3577.02
		LOCATION MAP	SCALE 1"=1000'	



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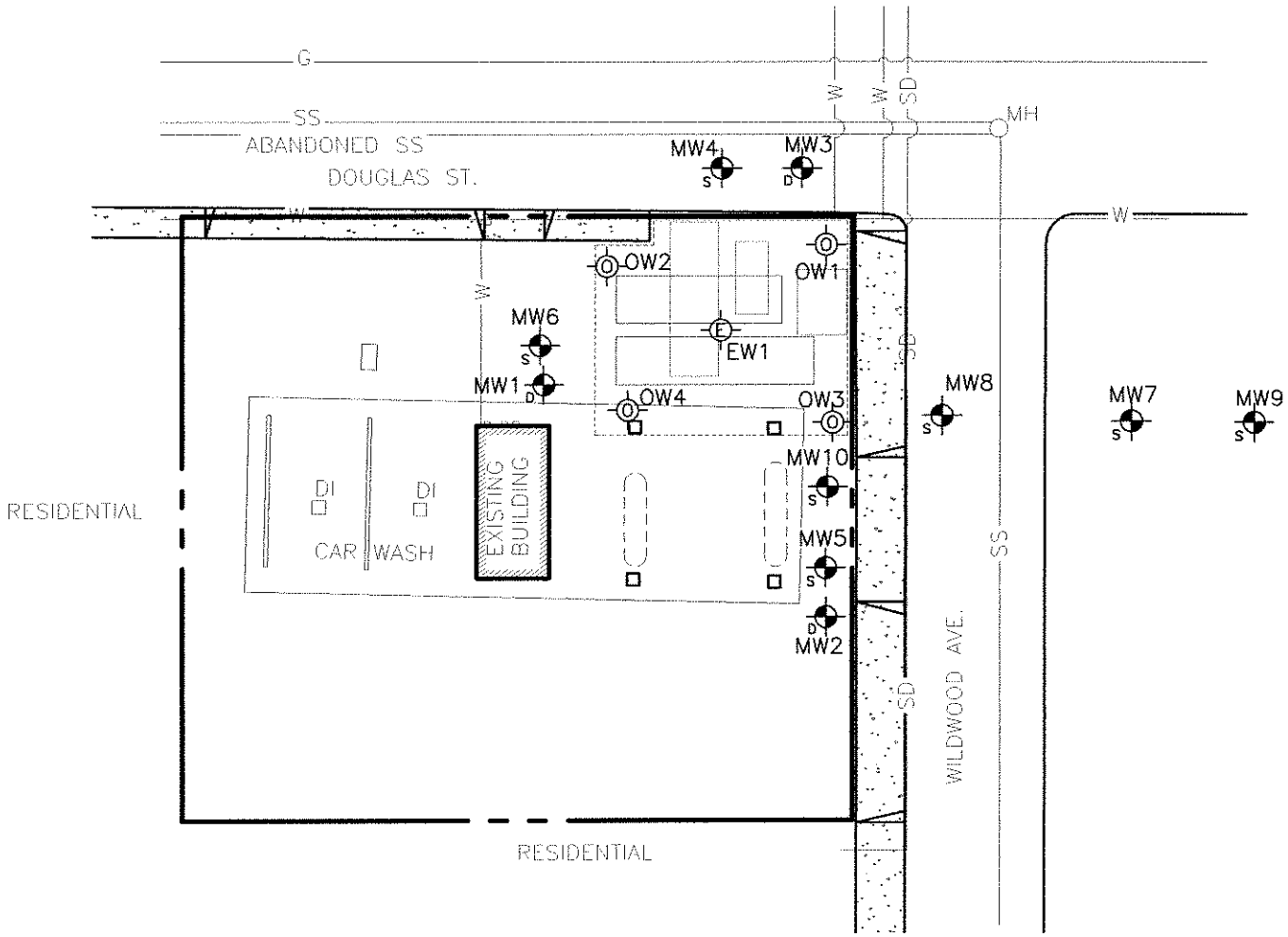
LACO ASSOCIATES CONSULTING ENGINEERS 21 W 4TH ST. EUREKA, CA 95501 (707)443-5054	PROJECT REMEDIAL ACTION PLAN	BY RJM	FIGURE 2
	CLIENT HUMBOLDT PETROLEUM INC	DATE 6/22/05	
	LOCATION 481 WILDWOOD AVE, RIO DELL	CHECK	JOB NO. 3577.02
	SITE MAP	SCALE 1"=30'	

LEGEND

- FORMER UST'S – REMOVED 1990
- UST'S REMOVED 4/21/99
- MONITORING WELL–SHALLOW
- MONITORING WELL–DEEP
- EXTRACTION WELL
- OBSERVATION WELL

0 15' 30'

SCALE: 1"=30'



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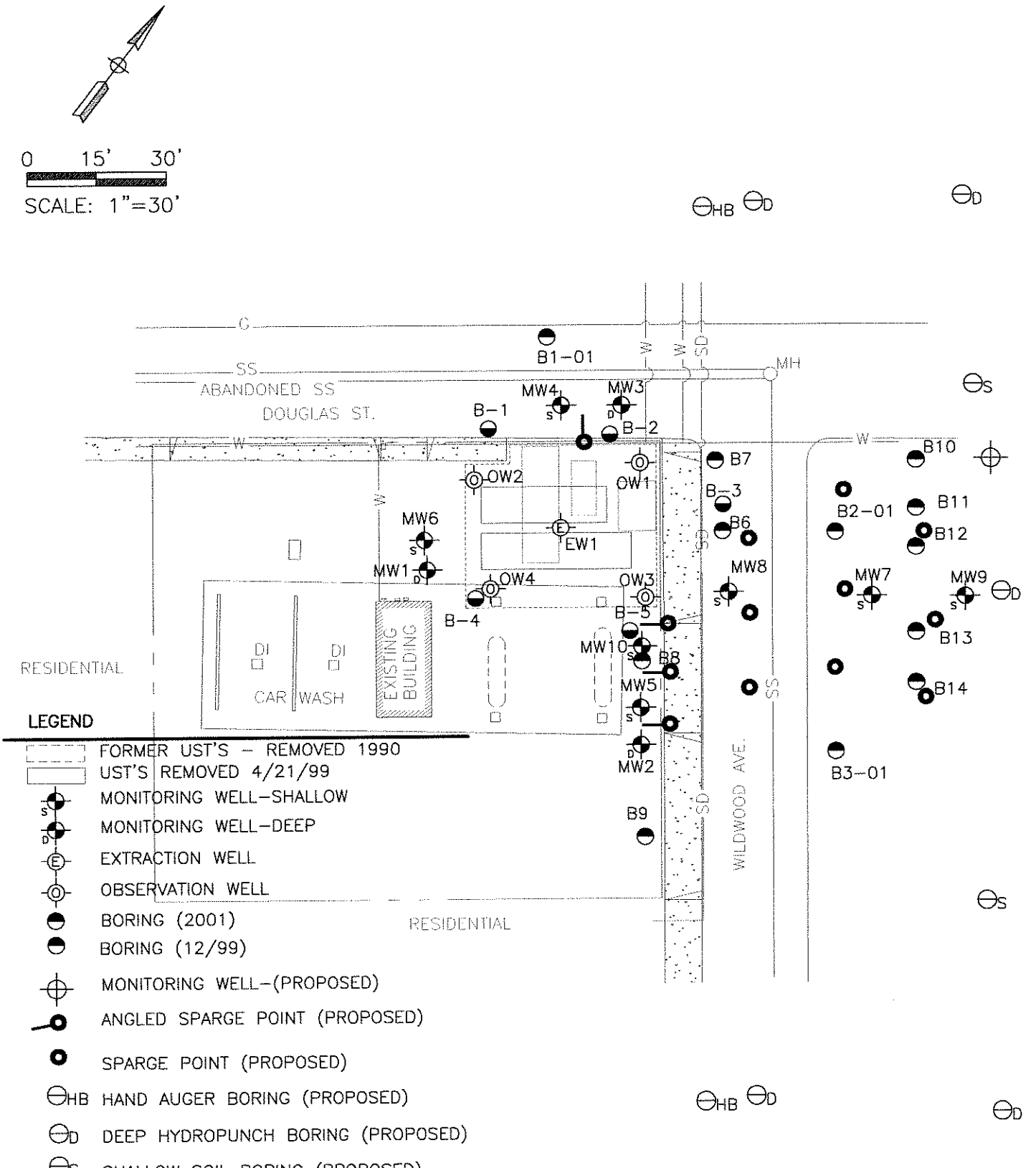
LACO ASSOCIATES CONSULTING ENGINEERS 21 W 4TH ST. EUREKA, CA 95501 (707)443-5054	PROJECT REMEDIAL ACTION PLAN	BY RJM	FIGURE 3
	CLIENT HUMBOLDT PETROLEUM INC	DATE 6/22/05	
	LOCATION 481 WILDWOOD AVE, RIO DELL	CHECK	JOB NO. 3577.02
	PROPOSED REMEDIAL SYSTEM, BORING AND MONITORING WELL MAP	SCALE 1"=30'	



Jun 28,2005-1:16pm
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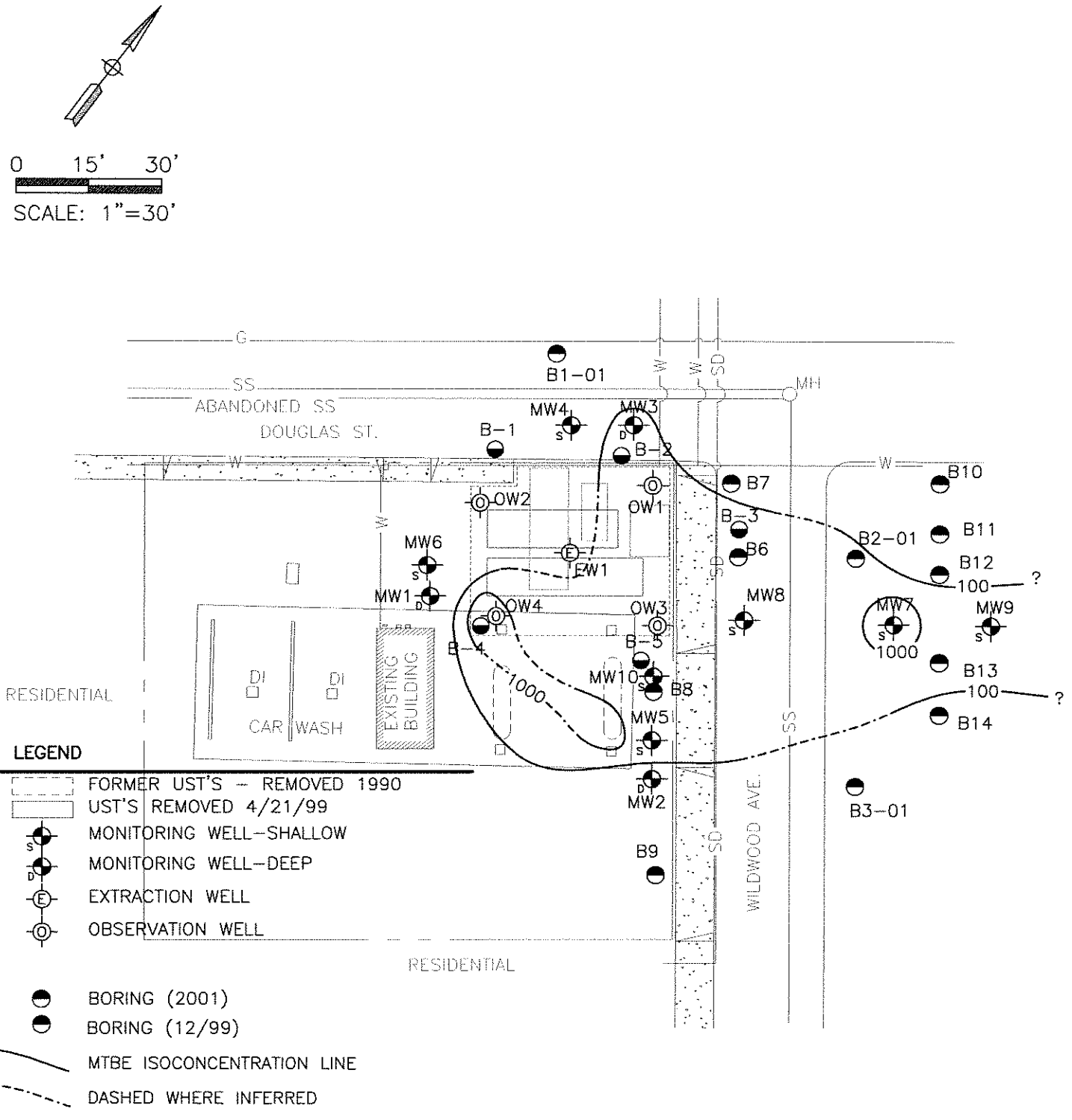
LACO ASSOCIATES CONSULTING ENGINEERS 21 W 4TH ST. EUREKA, CA 95501 (707)443-5054	PROJECT REMEDIAL ACTION PLAN	BY RJM	FIGURE 4
	CLIENT HUMBOLDT PETROLEUM INC	DATE 6/22/05	
	LOCATION 481 WILDWOOD AVE, RIO DELL	CHECK	JOB NO. 3577.02
	MTBE ISOCONCENTRATION MAP	SCALE 1"=30'	



NOTE: SOIL ANALYTICAL DATA CONVERTED TO GROUNDWATER CONCENTRATIONS WHERE NO GROUNDWATER ANALYTICAL DATA AVAILABLE

Jun 23,2005 - 12:02pm
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TABLE 1: HISTORIC SOIL ANALYSES
Former Rio Dell Shell, 481 Wildwood Avenue, Rio Dell, CA
LACO Project No. 3577.02; LOP No. 12261

Soil Sample ID	Sample Date	Depth (ft)	TPHg (µg/g)	MTBE (µg/g)	Benzene (µg/g)	Toluene (µg/g)	Ethylbenzene (µg/g)	m,p-Xylene (µg/g)	o-Xylene (µg/g)	TBA (µg/g)	DIPE (µg/g)	ETBE (µg/g)	TAME (µg/g)	Pb Scavengers (µg/g)
UST Closure														
3577-CAV1		4.5	<1.0	<0.050	<0.005	<0.005	<0.005	<0.005	---	---	---	---	---	---
3577-CAV2		4	<1.0	<0.005	<0.005	**0.0091**	<0.005	**0.0097**	---	<0.020	<0.020	<0.020	<0.020	<0.020
3577-CAV3		5	**3.3**	**0.11**	<0.005	<0.030	<0.040	<0.040	---	---	---	---	---	---
3577-PIPE1		---	**120**	**0.48**	**0.42**	<5.0	<1.6	<1.6	---	---	---	---	---	---
3577-PIPE2		---	<1.0	**0.11**	**0.0051**	<0.005	<0.005	**0.0068**	---	---	---	---	---	---
1999 Monitoring Well Installation														
3577 MW-1 @ 5'	12/16/99	5	<1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.5	<0.02	<0.02	<0.02	<0.02-0.04
3577 MW-1 @ 10'	12/16/99	10	<1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.5	<0.02	<0.02	<0.02	<0.02-0.04
3577 MW-1 @ 15'	12/16/99	15	<1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.5	<0.02	<0.02	<0.02	<0.02-0.04
3577 MW-1 @ 20'	12/16/99	20	<1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.5	<0.02	<0.02	<0.02	<0.02-0.04
3577 MW-2 @ 5'	12/17/99	5	<1	**0.041**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.5	<0.02	<0.02	<0.02	<0.02-0.04
3577 MW-2 @ 10'	12/17/99	10	<1	**0.066**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.5	<0.02	<0.02	<0.02	<0.02-0.04
3577 MW-2 @ 15'	12/17/99	15	<1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.5	<0.02	<0.02	<0.02	<0.02-0.04
3577 MW-2 @ 20'	12/17/99	20	<1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.5	<0.02	<0.02	<0.02	<0.02-0.04
3577 MW-2 @ 25'	12/17/99	25	<1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.5	<0.02	<0.02	<0.02	<0.02-0.04
3577 MW-3 @ 5'	12/17/99	5	<1	**0.016**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.5	<0.02	<0.02	<0.02	<0.02-0.04
3577 MW-3 @ 10'	12/17/99	10	<1	**0.012**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.5	<0.02	<0.02	<0.02	<0.02-0.04
3577 MW-3 @ 15'	12/17/99	15	<1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.5	<0.02	<0.02	<0.02	<0.02-0.04
3577 B-1 @ 5'	12/16/99	5	<1.0	<0.050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	---	---	---	---	---
3577 B-1 @ 10'	12/16/99	10	<1.0	<0.050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	---	---	---	---	---
3577 B-1 @ 15'	12/16/99	15	<1.0	<0.050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	---	---	---	---	---
3577 B-1 @ 20'	12/16/99	20	<1.0	<0.050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	---	---	---	---	---
3577 B-2 @ 5'	12/16/99	5	<1.0	<0.050	<0.0050	<0.0050	<0.0050	**0.014**	<0.0050	---	---	---	---	---
3577 B-2 @ 10'	12/16/99	10	<1.0	<0.050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	---	---	---	---	---
3577 B-2 @ 15'	12/16/99	15	<1.0	<0.050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	---	---	---	---	---
3577 B-2 @ 20'	12/16/99	20	<1.0	<0.050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	---	---	---	---	---
3577 B-3 @ 5'	12/16/99	5	<1.0	<0.050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	---	---	---	---	---
3577 B-3 @ 10'	12/16/99	10	<1.0	**0.11**	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	---	---	---	---	---
3577 B-3 @ 15'	12/16/99	15	<1.0	<0.050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	---	---	---	---	---
3577 B-3 @ 20'	12/16/99	20	<1.0	<0.050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	---	---	---	---	---

TABLE 1: HISTORIC SOIL ANALYSES
Former Rio Dell Shell, 481 Wildwood Avenue, Rio Dell, CA
LACO Project No. 3577.02; LOP No. 12261

Soil Sample ID	Sample Date	Depth (ft)	TPHg (µg/g)	MTBE (µg/g)	Benzene (µg/g)	Toluene (µg/g)	Ethylbenzene (µg/g)	m,p-Xylene (µg/g)	o-Xylene (µg/g)	TBA (µg/g)	DIPE (µg/g)	ETBE (µg/g)	TAME (µg/g)	Pb Scavengers (µg/g)
1999 Boring Installation														
3577 B-4 @ 4'	12/16/99	4	**1.2**	<0.050	<0.0050	**0.0081**	**0.0068**	**0.022**	**0.0068**	---	---	---	---	---
3577 B-4 @ 9'	12/16/99	9	**1.3**	**0.15**	**0.0074**	**0.030**	**0.040**	**0.066**	**0.018**	---	---	---	---	---
3577 B-5 @ 2-3'	12/17/99	2-3	**5.6**	**0.13**	**0.052**	<0.030	<0.040	**0.040**	<0.020	---	---	---	---	---
3577 B-5 @ 5'	12/17/99	5	<1.0	**0.051**	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	---	---	---	---	---
3577 B-5 @ 10'	12/17/99	10	<1.0	**0.075**	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	---	---	---	---	---
3577 B-5 @ 15'	12/17/99	15	<1.0	<0.050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	---	---	---	---	---
3577 B-5 @ 20'	12/17/99	20	<1.0	<0.050	<0.0050	<0.0050	<0.0050	**0.0054**	<0.0050	---	---	---	---	---
2001 Boring Installation														
B1-01	6/13/01	5	**4.0**	<0.050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	---	---	---	---	---
B1-01	6/13/01	9	**2.7**	<0.050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	---	---	---	---	---
B1-01	6/13/01	12	**3.7**	<0.050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	---	---	---	---	---
B2-01	6/13/01	5	<1.0	**0.060**	<0.0050	**0.0083**	<0.0050	**0.0089**	<0.0050	---	---	---	---	---
B2-01	6/13/01	9	<1.0	**0.073**	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	---	---	---	---	---
B2-01	6/13/01	12	<1.0	**0.19**	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	---	---	---	---	---
B3-01	6/13/01	5	<1.0	<0.050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	---	---	---	---	---
B3-01	6/13/01	9	<1.0	<0.050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	---	---	---	---	---
B3-01	6/13/01	12	<1.0	<0.050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	---	---	---	---	---
2001 Monitoring Well Installation														
MW-4	6/13/01	5	<1	**0.059**	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	---	---	---	---	---
MW-4	6/13/01	9	<1	<0.050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	---	---	---	---	---
MW-4	6/13/01	12	<1	<0.050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	---	---	---	---	---
MW-5	6/15/01	1	**110**	<0.050	**0.80**	<0.0050	<0.0050	<0.0050	<0.0050	---	---	---	---	---
MW-5	6/15/01	4	**400**	<5.0	**2.5**	<7.0	<3.0	<3.0	<3.0	---	---	---	---	---
MW-5	6/15/01	9	**110**	<0.20	**0.13**	<1.0	<1.0	<0.50	<1.0	---	---	---	---	---
MW-5	6/15/01	12	**18**	<0.050	**0.017**	<0.20	<0.15	<0.15	<0.15	---	---	---	---	---
MW-6	6/15/01	5	<1	<0.050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	---	---	---	---	---
MW-6	6/15/01	9	<1	<0.050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	---	---	---	---	---
MW-6	6/15/01	12	<1	<0.050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	---	---	---	---	---

TABLE 1: HISTORIC SOIL ANALYSES
Former Rio Dell Shell, 481 Wildwood Avenue, Rio Dell, CA
LACO Project No. 3577.02; LOP No. 12261

Soil Sample ID	Sample Date	Depth (ft)	TPHg (µg/g)	MTBE (µg/g)	Benzene (µg/g)	Toluene (µg/g)	Ethylbenzene (µg/g)	m,p-Xylene (µg/g)	o-Xylene (µg/g)	TBA (µg/g)	DIPE (µg/g)	ETBE (µg/g)	TAME (µg/g)	Pb Scavengers (µg/g)
2002 Boring Installation														
B-6	8/28/02	7.5	**1.0**	<0.025	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	---	---	---	---	---
B-8	8/28/02	4.25	**46**	<0.10	**0.14**	**0.0085**	**0.061**	**0.044**	**0.0057**	---	---	---	---	---
B-8	8/28/02	5.75	**110**	<0.025	**0.14**	**0.0065**	**0.095**	**0.032**	<0.0050	---	---	---	---	---
B-9	8/28/02	7.75	<1.0	<0.025	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	---	---	---	---	---
B-9	8/28/02	10.5	<1.0	<0.025	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	---	---	---	---	---
B-10	8/28/02	7.75	<1.0	<0.025	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	---	---	---	---	---
B-12	8/28/02	7	<1.0	<0.025	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	---	---	---	---	---
B-13	8/28/02	7.5	**1.0**	**0.053**	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	---	---	---	---	---
2004 Monitoring Well Installation														
MW-10	6/17/04	5.0	**1.2**	<0.050	<0.0050	<0.040	<0.010	<0.010	<0.0050	---	---	---	---	---
MW-10	6/17/04	10.0	<1.0	**0.095**	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	---	---	---	---	---

Notes

* Note: Original laboratory results for soil samples collected from monitoring wells were reported as µg/Kg.

ND = Not detected over the method detection limit
--- = Analyte not tested
µg/g = micrograms per gram
TPHg = Total petroleum hydrocarbons as gasoline
TPHd = Total petroleum hydrocarbons as diesel
Oxygenates (fuel additives): methyl tertiary butyl ether (MTBE), di-isopropyl ether (DIPE), ethyl tertiary butyl ether (ETBE), tert-amyl methyl ether (TAME) and tert-butyl alcohol (TBA).

TABLE 2: WELL DATA AND GROUNDWATER ANALYTICAL RESULTS
Former Rio Dell Shell, 481 Wildwood Avenue, Rio Dell, CA
LACO Project No. 3577.02; LOP No. 12261

Well ID	Sample Date	Well Head Elevation* (ft msl)	Water Surface Elevation (ft msl)	Depth to Water (ft)	Foot notes	TPHg (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Total Xylenes (µg/L)	MTBE (µg/L)	TBA (µg/L)	TAME (µg/L)	ETBE (µg/L)	DIPE (µg/L)	Methanol/ Ethanol (µg/L)
MW-1	**12/28/1999**	**135.21**	130.55	7.97		<50	<0.50	<0.50	<0.50	<0.50	<0.50	<10	<1.0	<1.0	<1.0	---
	2/24/2000		132.09	6.43		---	---	---	---	---	---	---	---	---	---	---
	3/21/2000		131.72	6.8		---	---	---	---	---	---	---	---	---	---	---
	4/18/2000		130.71	7.81		<50	<0.50	<0.50	<0.50	<0.50	<0.50	<10	<1.0	<1.0	<1.0	---
	5/26/2000		130.45	8.07		---	---	---	---	---	---	---	---	---	---	---
	6/30/2000		129.75	8.77		---	---	---	---	---	---	---	---	---	---	---
	7/31/2000		129.07	9.45		<50	<0.50	<0.50	<0.50	<0.50	<0.50	<10	<1.0	<1.0	<1.0	---
	8/30/2000		128.55	9.97		---	---	---	---	---	---	---	---	---	---	---
	9/22/2000		128.40	10.12		---	---	---	---	---	---	---	---	---	---	---
	10/26/2000		127.94	10.58		<50	<0.50	<0.50	<0.50	<0.50	<0.50	<10	<1.0	<1.0	<1.0	---
	11/24/2000		128.04	10.48		---	---	---	---	---	---	---	---	---	---	---
	12/12/2000		129.84	8.68		---	---	---	---	---	---	---	---	---	---	---
	1/12/2001		130.12	8.4		<50	<0.50	<0.50	<0.50	<0.50	<0.50	<5.0	<1.0	<1.0	<1.0	---
	2/22/2001		131.01	7.51		---	---	---	---	---	---	---	---	---	---	---
	4/5/2001		130.96	7.56		---	---	---	---	---	---	---	---	---	---	---
	5/2/2001		130.86	7.66		<50	<0.50	<0.50	<0.50	<0.50	<0.50	<5.0	<1.0	<1.0	<1.0	---
	6/14/01	**138.52**	**Reconstructed**													
	7/6/2001		129.07	**9.45**		<50	<0.50	<0.50	<0.50	<0.50	<0.50	<5.0	<1.0	<1.0	<1.0	**Ethanol =10**
	9/4/2001		127.86	10.66		---	---	---	---	---	---	---	---	---	---	---
	10/18/2001		127.07	11.45		<50	<0.50	<0.50	<0.50	<0.50	<0.50	<5.0	<1.0	<1.0	<1.0	---
	11/29/2001		128.52	10		---	---	---	---	---	---	---	---	---	---	---
	1/2/2002		131.33	7.19		<50	<0.50	<0.50	<0.50	<0.50	<0.50	<5.0	<1.0	<1.0	<1.0	---
	1/21/2002		130.92	**7.6**		<50	<0.50	<0.50	<0.50	<0.50	<0.50	<5.0	<1.0	<1.0	<1.0	**Methanol = 77**
	2/27/2002		131.38	7.14		---	---	---	---	---	---	---	---	---	---	---
	3/13/2002		131.01	7.51		<50	<0.50	<0.50	<0.50	<0.50	<0.50	<5.0	<1.0	<1.0	<1.0	---
	4/19/2002		130.42	8.1		---	---	---	---	---	---	---	---	---	---	---
	5/20/2002		130.44	8.08		---	---	---	---	---	---	---	---	---	---	---
	6/13/2002		129.62	8.9		<50	<0.50	<0.50	<0.50	<0.50	<0.50	<5.0	<1.0	<1.0	<1.0	---
	10/31/2002		---	---		---	---	---	---	---	---	---	---	---	---	---
	1/3/2003		131.04	7.48		---	---	---	---	---	---	---	---	---	---	---
	3/18/2003		133.81	4.71		---	---	---	---	---	---	---	---	---	---	---
	6/24/2003		129.83	8.69		---	---	---	---	---	---	---	---	---	---	---
	9/18/2003		128.20	10.32		---	---	---	---	---	---	---	---	---	---	---
	12/9/2003		129.17	9.35		---	---	---	---	---	---	---	---	---	---	---
	3/4/2004		131.69	6.83		---	---	---	---	---	---	---	---	---	---	---
	6/23/2004		129.47	9.05		---	---	---	---	---	---	---	---	---	---	---
	9/14/2004		127.54	10.98		---	---	---	---	---	---	---	---	---	---	---
	12/16/2004		129.63	8.89		---	---	---	---	---	---	---	---	---	---	---
	3/15/2005		130.94	7.58		---	---	---	---	---	---	---	---	---	---	---
	6/8/2005		130.82	7.7		---	---	---	---	---	---	---	---	---	---	---

TABLE 2: WELL DATA AND GROUNDWATER ANALYTICAL RESULTS
Former Rio Dell Shell, 481 Wildwood Avenue, Rio Dell, CA
LACO Project No. 3577.02; LOP No. 12261

Well ID	Sample Date	Well Head Elevation* (ft msl)	Water Surface Elevation (ft msl)	Depth to Water (ft)	Foot notes	TPHg (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Total Xylenes (µg/L)	MTBE (µg/L)	TBA (µg/L)	TAME (µg/L)	ETBE (µg/L)	DIPE (µg/L)	Methanol/ Ethanol (µg/L)
MW-2	12/28/1999	133.88	130.41	6.85		<50	<0.50	<0.50	<0.50	<0.50	1.8	<10	<1.0	<1.0	<1.0	---
	2/24/2000		131.97	5.29		---	---	---	---	---	---	---	---	---	---	---
	3/24/2000		131.59	5.67		---	---	---	---	---	---	---	---	---	---	---
	4/18/2000		130.56	6.7		<50	<0.50	<0.50	<0.50	<0.50	21	<10	<1.0	<1.0	<1.0	---
	5/26/2000		130.32	6.94		---	---	---	---	---	---	---	---	---	---	---
	6/30/2000		129.61	7.65		---	---	---	---	---	---	---	---	---	---	---
	7/31/2000		128.92	8.34		<50	<0.50	<0.50	<0.50	<0.50	8.8	<10	<1.0	<1.0	<1.0	---
	8/30/2000		128.41	8.85		---	---	---	---	---	---	---	---	---	---	---
	9/22/2000		128.28	8.98		---	---	---	---	---	---	---	---	---	---	---
	10/26/2000		128.03	9.23		<50	<0.50	<0.50	<0.50	<0.50	22	<10	<1.0	<1.0	<1.0	---
	11/24/2000		127.92	9.34		---	---	---	---	---	---	---	---	---	---	---
	12/12/2000		128.58	8.68		---	---	---	---	---	---	---	---	---	---	---
	1/12/2001		130.03	7.23		<50	<0.50	<0.50	<0.50	<0.50	39	<5.0	<1.0	<1.0	<1.0	---
	2/22/2001		131.45	5.81		---	---	---	---	---	---	---	---	---	---	---
	4/5/2001		130.76	6.5		---	---	---	---	---	---	---	---	---	---	---
	5/2/2001		130.56	6.7		<50	<0.50	<0.50	<0.50	<0.50	49	7.6	1.2	<1.0	<1.0	---
	6/15/01	137.26	Reconstructed													
	7/6/2001		129.19	8.07		<50	<0.50	<0.50	<0.50	<0.50	7.9	5.4	<1.0	<1.0	<1.0	---
	9/4/2001		128.02	9.24		---	---	---	---	---	---	---	---	---	---	---
	10/18/2001		127.06	10.2		74	<0.50	<0.50	<0.50	<0.50	5.1	12	<1.0	<1.0	<1.0	---
	11/29/2001		128.53	8.73		---	---	---	---	---	---	---	---	---	---	---
	1/2/2002		131.34	5.92		<100	<0.50	<0.50	<0.50	<0.50	5.4	<10	<1.0	<1.0	<1.0	---
	1/21/2002		130.92	6.34		<50	<0.50	<0.50	<0.50	<0.50	7.3	<5.0	<1.0	<1.0	<1.0	Methanol = 87
	2/27/2002		131.35	5.91		---	---	---	---	---	---	---	---	---	---	---
	3/13/2002		131.01	6.25		<50	<0.50	<0.50	<0.50	<0.50	8.0	<5.0	<1.0	<1.0	<1.0	---
	4/19/2002		130.42	6.84		---	---	---	---	---	---	---	---	---	---	---
	5/20/2002		130.41	6.85		---	---	---	---	---	---	---	---	---	---	---
	6/13/2002		129.80	7.46		<50	<0.50	<0.50	<0.50	<0.50	0.78	<5.0	<1.0	<1.0	<1.0	---
	10/31/2002		132.49	4.77		<50	<0.50	<0.50	<0.50	<0.50	6.3	<20	<1.0	<1.0	<1.0	---
	1/3/2003		131.16	6.1		<50	<0.50	<0.50	<0.50	<0.50	4.6	<20	<1.0	<1.0	<1.0	---
	3/18/2003		130.98	6.28		<50	<0.50	<0.50	<0.50	<0.50	11	<20	<1.0	<1.0	<1.0	---
	6/24/2003		129.79	7.47		<50	<0.50	<0.50	<0.50	<0.50	5.6	<20	<1.0	<1.0	<1.0	---
	9/18/2003		128.17	9.09		50	<0.50	<0.50	<0.50	<0.50	9.3	<20	<1.0	<1.0	<1.0	---
	12/9/2003		129.16	8.10		<50	<0.50	<0.50	<0.50	<0.50	7.0	<20	<1.0	<1.0	<1.0	---
	3/4/2004		131.65	5.61		<50	<0.50	<0.50	<0.50	<0.50	4.4	<10	<1.0	<1.0	<1.0	---
	6/23/2004		129.44	7.82		<50	<0.50	<0.50	<0.50	<0.50	18	<10	1.9	<1.0	<1.0	---
	9/14/2004		127.49	9.77		<50	<0.50	<0.50	<0.50	<0.50	19	<10	1.8	<1.0	<1.0	---
	12/16/2004		129.61	7.65		<50	<0.50	<0.50	<0.50	<0.50	18	<10	1.9	<1.0	<1.0	---
	3/15/2005		130.86	6.40		<50	<0.50	<0.50	<0.50	<0.50	12	<10	1.6	<1.0	<1.0	---
	6/8/2005		131.81	5.45		<50	<0.50	<0.50	<0.50	<0.50	8.5	<10	1.2	<1.0	<1.0	---

TABLE 2: WELL DATA AND GROUNDWATER ANALYTICAL RESULTS
Former Rio Dell Shell, 481 Wildwood Avenue, Rio Dell, CA
LACO Project No. 3577.02; LOP No. 12261

Well ID	Sample Date	Well Head Elevation* (ft msl)	Water Surface Elevation (ft msl)	Depth to Water (ft)	Foot notes	TPHg (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Total Xylenes (µg/L)	MTBE (µg/L)	TBA (µg/L)	TAME (µg/L)	ETBE (µg/L)	DIPE (µg/L)	Methanol/ Ethanol (µg/L)
MW-3	12/28/1999	134.11	130.55	6.64		73	<0.50	<0.50	<0.50	<0.50	240	<10	36	<1.0	<1.0	---
	2/24/2000		132.06	5.13		---	---	---	---	---	---	---	---	---	---	---
	3/21/2000		131.72	5.47		---	---	---	---	---	---	---	---	---	---	---
	4/18/2000		130.72	6.47		1,700	<1.0	<1.0	<1.0	<1.0	3,700	<50	500	<1.0	<1.0	---
	5/26/2000		130.44	6.75		---	---	---	---	---	---	---	---	---	---	---
	6/30/2000		129.76	7.43		---	---	---	---	---	---	---	---	---	---	---
	7/31/2000		129.08	8.11		1,900	<1.0	<1.0	<1.0	<1.0	2,400	<50	570	<1.0	<1.0	---
	8/30/2000		128.56	8.63		---	---	---	---	---	---	---	---	---	---	---
	9/22/2000		128.41	8.78		---	---	---	---	---	---	---	---	---	---	---
	10/26/2000		127.96	9.23		570	<2.5	<2.5	<2.5	<2.5	900	<100	180	<1.0	<1.0	---
	11/24/2000		128.11	9.08		---	---	---	---	---	---	---	---	---	---	---
	12/12/2000		128.53	8.66		---	---	---	---	---	---	---	---	---	---	---
	1/12/2001		130.08	7.11		380	<2.0	<2.0	<2.0	<2.0	1,600	<20	360	<1.0	<1.0	---
	2/22/2001		131.08	6.11		---	---	---	---	---	---	---	---	---	---	---
	4/5/2001		130.97	6.22		---	---	---	---	---	---	---	---	---	---	---
	5/2/2001		130.81	6.38		350	<2.5	<2.5	<2.5	<2.5	1,300	27	320	<1.0	<1.0	---
	6/13/01	137.19	Reconstructed													---
	7/6/2001		129.24	7.95		<200	<2.0	<2.0	<2.0	<2.0	670	<20	140	<1.0	<1.0	---
	9/4/2001		128.31	8.88		---	---	---	---	---	---	---	---	---	---	---
	10/18/2001		127.06	10.13		140	<0.50	<0.50	<0.50	<0.50	410	15	90	0.59	<1.0	
	11/29/2001		128.46	8.73		---	---	---	---	---	---	---	---	---	---	---
	1/2/2002		131.30	5.89		290	<1.0	<1.0	<1.0	<1.0	330	<20	61	<1.0	<1.0	---
	1/21/2002		130.92	6.27		240	<0.50	<0.50	<0.50	<0.50	300	<10	47	<1.0	<1.0	Methanol = 82
	2/27/2002		131.29	5.9		---	---	---	---	---	---	---	---	---	---	---
	3/13/2002		130.97	6.22		120	<0.50	<0.50	<0.50	<0.50	190	<5.0	24	<1.0	<1.0	---
	4/19/2002		130.33	6.86		---	---	---	---	---	---	---	---	---	---	---
	5/20/2002		130.45	6.74		---	---	---	---	---	---	---	---	---	---	---
	6/13/2002		129.84	7.35		160	<0.50	<0.50	<0.50	<0.50	380	<5.0	34	1.2	<1.0	---
	10/31/2002		126.96	10.23		110	<0.50	<0.50	<0.50	<0.50	210	<20	18	1.3	<1.0	---
	1/3/2003		130.99	6.2		100	<0.50	<0.50	<0.50	<0.50	140	21	8.1	<1.0	1.1	---
	3/18/2003		131.04	6.15		150	<0.50	<0.50	<0.50	<0.50	210	<20	23	<1.0	<1.0	---
	6/24/2003		129.83	7.36		270	<0.50	<0.50	<0.50	<0.50	280	<20	28	1.3	<1.0	---
	9/18/2003		128.19	9.00		210	<0.50	<0.50	<0.50	<0.50	130	<20	7.4	<1.0	<1.0	---
	12/9/2003		129.18	8.01		120	<0.50	<0.50	<0.50	<0.50	150	<20	12	<1.0	<1.0	---
	3/4/2004		131.65	5.54		200	<0.50	<0.50	<0.50	<0.50	210	<10	16	<1.0	<1.0	---
	6/23/2004		129.47	7.72	3	170	<0.50	<0.50	<0.50	<0.50	150	<10	9.7	<1.0	<1.0	---
	9/14/2004		127.53	9.66	3,6	150	<0.50	<0.50	<0.50	<0.50	120	<15	7.2	<1.0	<1.0	---
	12/16/2004		129.62	7.57	3,6	200	<0.50	<0.50	<0.50	<0.50	160	<15	10	<1.0	<1.0	---
	3/15/2005		130.87	6.32		140	<0.50	<0.50	<0.50	<0.50	180	<10	15	<1.0	<1.0	---
	6/8/2005		130.81	6.38		210	<0.50	<0.50	<0.50	<0.50	180	<10	14	<1.0	<1.0	---

TABLE 2: WELL DATA AND GROUNDWATER ANALYTICAL RESULTS
Former Rio Dell Shell, 481 Wildwood Avenue, Rio Dell, CA
LACO Project No. 3577.02; LOP No. 12261

Well ID	Sample Date	Well Head Elevation* (ft msl)	Water Surface Elevation (ft msl)	Depth to Water (ft)	Foot notes	TPHg (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Total Xylenes (µg/L)	MTBE (µg/L)	TBA (µg/L)	TAME (µg/L)	ETBE (µg/L)	DIPE (µg/L)	Methanol/ Ethanol (µg/L)
MW-4	7/6/2001	137.33	128.84	8.49		<50	<0.50	<0.50	<0.50	<0.50	72	8.7	13	<1.0	<1.0	---
	9/4/2001		131.58	5.75												
	10/18/2001		130.90	6.43		86	<0.50	<0.50	<0.50	<0.50	160	9.5	35	<1.0	<1.0	---
	11/29/2001		132.68	4.65												
	1/2/2002		133.86	3.47		140	<0.50	<0.50	<0.50	<0.50	160	9	40	<1.0	<1.0	Methanol=57
	1/21/2002		134.01	3.32		160	<0.50	<0.50	<0.50	<0.50	190	<5.0	45	<1.0	<1.0	Methanol = 56
	2/27/2002		134.49	2.84		---	---	---	---	---	---	---	---	---	---	---
	3/13/2002		133.83	3.50		<50	<0.50	<0.50	<0.50	<0.50	68	<5.0	13	<1.0	<1.0	---
	4/19/2002		133.97	3.36		---	---	---	---	---	---	---	---	---	---	---
	5/20/2002		134.08	3.25		---	---	---	---	---	---	---	---	---	---	---
	6/13/2002		133.51	3.82		<50	<0.50	<0.50	<0.50	<0.50	28	<5.0	4.6	<1.0	<1.0	Ethanol = 6.7
	10/31/2002		130.84	6.49		<50	<0.50	<0.50	<0.50	<0.50	41	<20	7.9	<1.0	<1.0	---
	1/3/2003		133.92	3.41		<50	<0.50	<0.50	<0.50	<0.50	22	<20	3.6	<1.0	<1.0	---
	3/18/2003		131.32	6.01		<50	<0.50	<0.50	<0.50	<0.50	22	<20	3.8	<1.0	<1.0	---
	6/24/2003		129.77	7.56		68	<0.50	<0.50	<0.50	<0.50	32	<20	4.5	<1.0	<1.0	---
	9/18/2003		129.46	7.87		94	<0.50	<0.50	<0.50	<0.50	33	<20	4.6	<1.0	<1.0	---
	12/9/2003		130.17	7.16		<50	<0.50	<0.50	<0.50	<0.50	16	<20	2.3	<1.0	<1.0	---
	3/4/2004		130.70	6.63		<50	<0.50	<0.50	<0.50	<0.50	27	<10	3.1	<1.0	<1.0	---
	6/23/2004		129.80	7.53		<50	<0.50	<0.50	<0.50	0.5	24	<10	4.2	<1.0	<1.0	---
	9/14/2004		129.27	8.06		<50	<0.50	<0.50	<0.50	<0.50	15	<10	2.1	<1.0	<1.0	---
	12/16/2004		129.64	7.69	2	<50	<0.50	<0.50	<0.50	<0.50	12	<10	1.6	<1.0	<1.0	---
	3/15/2005		129.61	7.72		<50	<0.50	<0.50	<0.50	<0.50	23	<10	3.5	<1.0	<1.0	---
	6/8/2005		129.40	7.93		54	<0.50	<0.50	<0.50	<0.50	23	<10	3.4	<1.0	<1.0	---
MW-5	7/6/2001	137.11	127.07	10.04		<100	<1.0	<1.0	<1.0	<1.0	340	150	50	<1.0	<1.0	---
	9/4/2001		131.26	5.85		---	---	---	---	---	---	---	---	---	---	---
	10/18/2001		131.96	5.15		1,200	150	<2.5	19	9.8	1,000	330	250	<1.0	<1.0	---
	11/29/2001		133.22	3.89		---	---	---	---	---	---	---	---	---	---	---
	1/2/2002		133.86	3.25		2,200	370	2.9	26	8.5	1,200	290	280	<1.0	<1.0	Methanol = 130
	1/21/2002		133.72	3.39		2,400	380	2.9	27	6.1	1,400	<30	320	<1.0	<1.0	Methanol = 80
	2/27/2002		132.95	4.16		---	---	---	---	---	---	---	---	---	---	---
	3/13/2002		130.43	6.68		910	85	1.1	11	3.9	790	<20	170	<1.0	<1.0	---
	4/19/2002		133.48	3.63		---	---	---	---	---	---	---	---	---	---	---
	5/20/2002		134.03	3.08		---	---	---	---	---	---	---	---	---	---	---
	6/13/2002		133.78	3.33		1,500	270	1.7	15	3.2	1,400	380	250	<1.0	<1.0	Methanol = 120
	10/31/2002		132.39	4.72		2,200	420	3.6	24	5.56	1,200	470	340	1.2	<1.0	---
	1/3/2003		135.14	1.97		1,100	190	ND<5.0	8.1	ND<5.0	770	<20	210	<1.0	<1.0	---
	3/18/2003		133.64	3.47		1,600	310	2.2	17	2.60	710	110	160	<1.0	<1.0	---
	6/24/2003		132.90	4.21		2,300	280	2.0	24	1.80	780	150	180	<1.0	<1.0	---
	9/18/2003		132.00	5.11		1,700	32	1.0	10	1.30	910	99	210	<1.0	<1.0	---
	12/9/2003		132.38	4.73		1,000	17	0.65	7.1	1.30	880	94	210	<1.0	<1.0	---
	3/4/2004		133.54	3.57		1,400	95	1.1	7.2	0.98	940	130	180	<1.0	<1.0	---
	6/23/2004		133.29	3.82	2	1,600	51	0.75	5.3	1.2	760	130	170	<1.0	<1.0	---
	9/14/2004		132.85	4.26	2	1,500	14	<0.50	2.3	0.68	650	100	120	<1.0	<1.0	---
	12/16/2004		135.08	2.03		1,300	14	<0.50	1.8	0.56	670	90	120	<1.0	<1.0	---
	3/15/2005		133.73	3.38		890	2.7	<0.50	1.6	0.59	560	<10	130	<1.0	<1.0	---
	6/8/2005		133.76	3.35		1,300	16	<0.50	1.3	0.53	540	86	110	<1.0	<1.0	---

TABLE 2: WELL DATA AND GROUNDWATER ANALYTICAL RESULTS
Former Rio Dell Shell, 481 Wildwood Avenue, Rio Dell, CA
LACO Project No. 3577.02; LOP No. 12261

Well ID	Sample Date	Well Head Elevation* (ft msl)	Water Surface Elevation (ft msl)	Depth to Water (ft)	Foot notes	TPHg (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Total Xylenes (µg/L)	MTBE (µg/L)	TBA (µg/L)	TAME (µg/L)	ETBE (µg/L)	DIPE (µg/L)	Methanol/ Ethanol (µg/L)
MW-6	7/6/2001	138.52	129.57	8.95		<50	<0.50	<0.50	<0.50	<0.50	1.0	<5.0	<1.0	<1.0	<1.0	---
	9/4/2001		129.46	9.06		---	---	---	---	---	---	---	---	---	---	---
	10/18/2001		130.36	8.16		57	<0.50	<0.50	<0.50	<0.50	2.1	<5.0	<1.0	<1.0	<1.0	---
	11/29/2001		131.56	6.96		---	---	---	---	---	---	---	---	---	---	---
	1/2/2002		133.19	5.33		<50	<0.50	<0.50	<0.50	<0.50	0.81	<5.0	<1.0	<1.0	<1.0	---
	1/21/2002		134.03	4.49		<50	<0.50	<0.50	<0.50	<0.50	1.4	<5.0	<1.0	<1.0	<1.0	Methanol = 64
	2/27/2002		132.35	6.17		---	---	---	---	---	---	---	---	---	---	---
	3/13/2002		132.71	5.81		<50	<0.50	<0.50	<0.50	<0.50	<0.50	<5.0	<1.0	<1.0	<1.0	---
	4/19/2002		134.04	4.48		---	---	---	---	---	---	---	---	---	---	---
	5/20/2002		134.21	4.31		---	---	---	---	---	---	---	---	---	---	---
	6/13/2002		134.06	4.46		59	0.9	<0.50	<0.50	<0.50	0.99	<5.0	<1.0	<1.0	<1.0	---
	10/31/02		132.24	6.28		<50	2.5	<0.50	<0.50	<0.50	<0.50	<5.0	<1.0	<1.0	<1.0	---
	1/3/03		133.11	5.41		70	<0.50	<0.50	<0.50	<0.50	<1.0	<20	<1.0	<1.0	<1.0	---
	3/18/03		132.77	5.75		58	<0.50	<0.50	<0.50	<0.50	<1.0	<20	<1.0	<1.0	<1.0	---
	6/24/2003		131.24	7.28		120	0.65	<0.50	<0.50	<0.50	1.0	<20	<1.0	<1.0	<1.0	---
	9/18/2003		130.55	7.97		110	<0.50	<0.50	<0.50	<0.50	<1.0	<20	<1.0	<1.0	<1.0	---
	12/9/2003		130.61	7.91		52	<0.50	<0.50	<0.50	<0.50	<1.0	<20	<1.0	<1.0	<1.0	---
	3/4/2004		130.95	7.57	4	68	<0.50	<0.50	<0.50	<0.50	<1.0	<30	<1.0	<1.0	<1.0	---
	6/23/2004		130.66	7.86	2	68	0.75	<0.50	<0.50	<0.50	<1.0	<30	<1.0	<1.0	<1.0	---
	9/14/2004		130.15	8.37		<50	<0.50	<0.50	<0.50	<0.50	<1.0	<10	<1.0	<1.0	<1.0	---
	12/16/2004		130.37	8.15		<50	<0.50	<0.50	<0.50	<0.50	<1.0	<10	<1.0	<1.0	<1.0	---
	3/15/2005		130.64	7.88		63	<0.50	<0.50	<0.50	<0.50	<1.0	<50	<1.0	<1.0	<1.0	---
	6/8/2005		130.45	8.07		61	<0.50	<0.50	<0.50	<0.50	1.1	<50	<1.0	<1.0	<1.0	---
MW-7	10/31/2002	137.08	127.22	9.86		1,100	<0.50	<0.50	<0.50	<0.50	2,200	1,200	39	23	<1.0	---
	1/3/2003		131.69	5.39		200	<0.50	<0.50	<0.50	<0.50	260	56	<1.0	<1.0	<1.0	---
	3/18/2003		131.58	5.50		420	<0.50	<0.50	<0.50	<0.50	620	130	22	8.5	<1.0	---
	6/24/2003		130.65	6.43		720	<0.50	<0.50	<0.50	<0.50	1,000	260	45	8.6	<1.0	---
	9/18/2003		129.77	7.31		900	<0.50	<0.50	<0.50	<0.50	1,000	190	45	6.8	<1.0	---
	12/9/2003		129.76	7.32		710	<0.50	<0.50	<0.50	<0.50	1,000	220	64	7.4	<1.0	---
	3/4/2004		130.65	6.43		910	<0.50	<0.50	<0.50	<0.50	1,300	320	80	7.3	<1.0	---
	6/23/2004		130.06	7.02	3	1,100	<0.50	<0.50	<0.50	<0.50	1,200	240	78	7.3	<1.0	---
	9/14/2004		129.35	7.73	3	1,300	<0.50	<0.50	<0.50	<0.50	1,000	210	73	5.7	<1.0	---
	12/16/2004		129.85	7.23	3	1,200	<0.50	<0.50	<0.50	<0.50	1,100	160	79	5.6	<1.0	---
	3/15/2005		130.01	7.07		810	<0.50	<0.50	<0.50	<0.50	1,100	140	90	6.2	<1.0	---
	6/8/2005		130.63	6.45		1,100	<0.50	<0.50	<0.50	<0.50	1,100	95	89	5.9	<1.0	---
MW-8	10/31/02	136.64	126.38	10.26		220	<0.50	<0.50	<0.50	0.51	400	560	26	2.9	<1.0	---
	1/3/03		132.88	3.76		160	<0.50	<0.50	<0.50	<0.50	210	67	28	4.6	<1.0	---
	3/18/03		131.79	4.85		270	<0.50	<0.50	<0.50	<0.50	380	59	67	4.2	<1.0	---
	6/24/2003		130.93	5.71		420	<0.50	<0.50	<0.50	<0.50	460	120	76	3.3	<1.0	---
	9/18/2003		130.81	5.83		830	<0.50	<0.50	<0.50	<0.50	830	160	88	4.7	<1.0	---
	12/9/2003		134.71	1.93		260	<0.50	<0.50	<0.50	<0.50	300	74	40	2.2	<1.0	---
	3/4/2004		132.63	4.01		570	<0.50	<0.50	<0.50	<0.50	630	270	84	4.3	<1.0	---
	6/23/2004		131.43	5.21	3	810	<0.50	<0.50	<0.50	<0.50	700	190	88	4.2	<1.0	---
	9/14/2004		131.11	5.53	3	500	<0.50	<0.50	<0.50	<0.50	360	77	54	1.9	<1.0	---
	12/16/2004		131.69	4.95	3	730	<0.50	<0.50	<0.50	<0.50	600	130	69	3.2	<1.0	---
	3/15/2005		131.39	5.25		410	<0.50	<0.50	<0.50	<0.50	520	180	56	3.9	<1.0	---
	6/8/2005		130.04	6.6		340	<0.50	<0.50	<0.50	<0.50	300	57	33	1.9	<1.0	---

TABLE 2: WELL DATA AND GROUNDWATER ANALYTICAL RESULTS
Former Rio Dell Shell, 481 Wildwood Avenue, Rio Dell, CA
LACO Project No. 3577.02; LOP No. 12261

Well ID	Sample Date	Well Head Elevation* (ft msl)	Water Surface Elevation (ft msl)	Depth to Water (ft)	Foot notes	TPHg (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Total Xylenes (µg/L)	MTBE (µg/L)	TBA (µg/L)	TAME (µg/L)	ETBE (µg/L)	DIPE (µg/L)	Methanol/ Ethanol (µg/L)
MW-9	10/31/02	136.46	125.46	11.00		200	<0.50	<0.50	<0.50	<0.50	330	230	2.5	3.4	<1.0	---
	1/3/03		128.96	7.50		66	<0.50	<0.50	<0.50	<0.50	69	54	<1.0	3.5	<1.0	---
	3/18/03		130.86	5.60		180	<0.50	<0.50	<0.50	<0.50	280	59	<1.0	4.2	<1.0	---
	6/24/2003		130.38	6.08		420	<0.50	<0.50	<0.50	<0.50	420	200	1.2	5.6	1.1	---
	9/18/2003		129.09	7.37		450	<0.50	<0.50	<0.50	<0.50	460	150	1.2	4.6	1.1	---
	12/9/2003		128.88	7.58		320	<0.50	<0.50	<0.50	<0.50	400	140	1.2	4.5	<1.0	---
	3/4/2004		129.53	6.93		420	<0.50	<0.50	<0.50	<0.50	500	250	1.2	5.2	<1.0	---
	6/23/2004		128.71	7.75	3	460	<0.50	<0.50	<0.50	<0.50	470	160	1.4	4.7	<1.0	---
	9/14/2004		127.84	8.62	3	460	<0.50	<0.50	<0.50	<0.50	370	100	1.0	3.7	<1.0	---
	12/16/2004		128.10	8.36	3	460	<0.50	<0.50	<0.50	<0.50	410	100	<1.0	3.8	<1.0	---
	3/15/2005		129.48	6.98		320	<0.50	<0.50	<0.50	<0.50	420	160	1.2	4.4	<1.0	---
	6/8/2005		129.54	6.92		400	<0.50	<0.50	<0.50	<0.50	370	100	1.1	4.0	<1.0	---
MW-10	6/23/2004	137.52	133.80	3.72	3, 4	160	<0.50	<0.50	<0.50	<0.50	140	<60	17	<1.0	<1.0	---
	9/14/2004		132.97	4.55	5,6	130	<0.50	<0.50	<0.50	<0.50	94	<30	8.2	<1.0	<1.0	---
	12/16/2004		134.41	3.11	3	410	<0.50	<0.50	<0.50	<0.50	350	62	29	<1.0	<1.0	---
	3/15/2005		133.59	3.93		340	<0.50	<0.50	<0.50	<0.50	400	140	41	1.2	<1.0	---
	6/8/2005		133.10	4.42		420	<0.50	<0.50	<0.50	<0.50	370	88	38	<2.0	<1.0	---

*Reference NAVD 88, 11/02.
Elevations of 8/15/02 set by R. Smith, LS. Used Caltrans HPGN monument "D CA 01 NC" south of Rio Dell @ Jordan Road/Hwy. 254 (Pepperwood) off-ramp

Laboratory Notations

[1] Samples does not present a peak pattern consistent with that of gasoline.

[2] The gasoline value includes the reported gasoline components and additives in addition to other peaks in the gasoline range

[3] The gasoline value is primarly from the reported gasoline additives.

[4] TBA reporting limit was raised due to matrix interference.

[5] The gasoline value includes the reported gasoline addditives in addition to other peaks in the gasoline range.

[6] Some reporting limits were raised due to matrix interfernce.

[7] The travel blank for this work order was prepared with water that had a high background of MTBE.
The containers for this project were not affected as demonstrated by the ND results for sample MW6 (9/14/04)

WORKSHEET 1: TOTAL CONTAMINANT MASS CALCULATIONS
Former Rio Dell Shell, 481 Wildwood Avenue, Rio Dell, CA
LACO Project No. 3577.02; LOP No. 12261

MASS OF SORBED TPH
Define areas of contamination by concentration amount

		Secondary Source
Average Concentration:	100 µg/g	1 µg/g
Area of contamination **(A)**:	315 ft^2	2335 ft^2
Depth of contamination **(B)**:	4 ft	4 ft
Volume of contamination **(A*B=C)**:	1260 ft^3	9340 ft^3
Convert ft^3 to cubic centimeters multiply 28316.8:	35679168 cc	264478912 cc
Multiply density of soil (1.5 g/cc) to get the weight of the contaminated soil:	53518752 g	396718368 g
Multiply by contaminant concentration (µg/g):	5351875200 µg	396718368 µg
Convert to kilograms:	5.35 kg	0.40 kg
TOTAL SORBED TPH MASS:		5.75 kg

MASS OF DISSOLVED TPH
Define areas of contamination by concentration amount

Average Concentration:	900 µg/L	100 µg/L
Area of contamination **(A)**:	491 ft^2	2159 ft^2
Depth of contamination **(B)**:	7 ft	7 ft
Volume of contamination **(A*B=C)**:	3437 ft^3	15113 ft^3
Convert ft^3 to liters multiply 28.3168:	97324.8416 L	427951.7984 L
Multiply by 40% (water to soil ratio):	38929.93664 L	171180.7194 L
Multiply by contaminant concentration (µg/L):	35036942.98 µg	17118071.94 µg
Convert to kilograms:	0.0350 kg	0.0171 kg
TOTAL DISSOLVED TPH MASS:		0.0522 kg

WORKSHEET 1: TOTAL CONTAMINANT MASS CALCULATIONS
Former Rio Dell Shell, 481 Wildwood Avenue, Rio Dell, CA
LACO Project No. 3577.02; LOP No. 12261

MASS OF DISSOLVED MTBE
Define areas of contamination by concentration amount

Average Concentration:	1,000 µg/L	100 µg/L
Area of contamination **(A)**:	491 ft^2	2159 ft^2
Depth of contamination **(B)**:	7 ft	7 ft
Volume of contamination **(A*B=C)**:	3437 ft^3	15113 ft^3
Convert ft^3 to liters multiply 28.3168:	97324.8416 L	427951.7984 L
Multiply by 40% (water to soil ratio):	38929.93664 L	171180.7194 L
Multiply by contaminant concentration (µg/L):	38929936.64 µg	17118071.94 µg
Convert to grams:	38.93 g	17.12 g

TOTAL DISSOLVED MTBE MASS: 56.05 g

MASS OF DISSOLVED OXYs
Define areas of contamination by concentration amount

Average Concentration:	100 µg/L
Area of contamination **(A)**:	2650 ft^2
Depth of contamination **(B)**:	7 ft
Volume of contamination **(A*B=C)**:	18550 ft^3
Convert ft^3 to liters multiply 28.3168:	525276.64 L
Multiply by 40% (water to soil ratio):	210110.656 L
Multiply by contaminant concentration (µg/L):	21011065.6 µg
Convert to grams:	21.0 g

TOTAL DISSOLVED OXYs MASS: 21.0 g

WORKSHEET 2: OXIDANT DEMAND CALCULATIONS
Former Rio Dell Shell, 481 Wildwood Avenue, Rio Dell, CA
LACO Project No. 3577.02; LOP No. 12261

Ozone mass discharge (gm/min) = C_{avg} * Q * D = Average concentration (ppm_V) * ozone injection concentration/flow rate (ft^3/min) * ozone density (gm/L) * conversion factor

Cavg	1,100	ppm_V
Q	3	(ft^3/min)
D	2.144	(gm/L)
Conversion Factor	2.83286E-05	(1L/0.0353 ft^3)*(1/1000000)

Ozone Mass Discharge	0.200	gm/min
Ozone Mass Discharge	12.026	gm/hr

WORKSHEET 2: OXIDANT DEMAND CALCULATIONS
Former Rio Dell Shell, 481 Wildwood Avenue, Rio Dell, CA
LACO Project No. 3577.02; LOP No. 12261

Time Calculation : number of years until remedial goals are met
Assumptions:
15 - 20% mass TPHg = mass ozone (assume 17.5%)
1 kg MTBE : 2.5 kg ozone (80% of MTBE degradation at pH = 8)
1 kg oxygenate : 2.5 - 4 kg ozone (assume 3.25)
2 kg metals : 1 kg ozone
30% total organic content = mass ozone

mass dissolved MTBE	0.056	(kg)	:	mass O_3	0.140	(kg)
mass sorbed TPH	5.750	(kg)	:	mass O_3	1.006	(kg)
mass dissolved TPH	0.052	(kg)	:	mass O_3	0.009	(kg)
dissolved oxys	0.021	(kg)	:	mass O_3	0.068	(kg)
Dissolved Iron	0.880	(kg)	:	mass O_3	0.440	(kg)
TOC	1,047	(kg)	:	mass O_3	314	(kg)
				kg O_3 needed:	**316**	

Time (in years) until target at O_3 mass discharge (calculated on Page 1)?	3.00

WORKSHEET 3: RADIUS OF INFLUENCE CALCULATIONS
Former Rio Dell Shell, 481 Wildwood Avenue, Rio Dell, CA
LACO Project No. 3577.02; LOP No. 12261

Pc=	critical pressure to induce flow (psi) = $P_L+(H_2-H_1)+P_F$	H_1	0	0	0
P_{OP}=	operating pressure (psi) =P_C+P_F	H_2	9	7.25	5.5
H_1=	reference head at sparge point (ft)	P_L	2.5	2.5	2.5
H_2=	hydraulic head (ft)	P_S	2	2	2
P_L=	design line pressure loss per 100 ft=2.5 psi	P_F	3	3	3
P_F=	formation backpressure=3 psi	Pc	13.5	11.75	10
P_S=	pressure loss at Spargepoint=2 psi	P_{OP}	16.5	14.75	13
		ROI	9.95	8.12	6.27
ROI=	radius of influence (ft) for Kv=Kh = $(P_{OP}/P_C)^{1/2}$ X (H_2-H_1)	1:10 ROI (ft)	14.92	12.18	9.41
	if Kv:Kh=1:10 ROI X 1.5	1:100 ROI (ft)	19.90	16.25	12.54
	if Kv:Kh=1:100 ROI X 2	AVERAGE 1:10 ROI (ft)		**12.17**	
		AVERAGE 1:100 ROI (ft)		**16.23**	
SPARGE WELL SPACING FOR 30% OVERLAP= 3/4 (2R)		1:100 SPARGE WELL SPACING (ft)		**18**	
		1:10 SPARGE WELL SPACING (ft)		**24**	

Attachment 1

LACO ASSOCIATES
STANDARD OPERATING PROCEDURE No. 1 (revised September 2002)
Hazardous Materials Investigation Procedures

SCOPE

Standard Operating Procedures (SOP) No.1 is for the implementation of hazardous material investigation procedures including pre-site activities, field methodologies, and post-field work activities. Monitoring well sampling is covered in SOP No.2. SOP No.1 will be used by HAZWOPER-certified personnel in conjunction with the drilling file provided by the Project Manager to complete the required tasks in a consistent and standardized manner. Each section covers a specific task. Where multiple tasks are involved, refer to the appropriate section(s).

SOP No.1 will be reviewed annually through a systematic evaluation by Environmental Department personnel. If revised, an updated SOP will be published and forwarded to the appropriate regulatory agencies and personnel by January 31 of each new year.

PREPARATION AND COMPLETION

Pre-field Activities

The Project Manager will initiate the project by starting a drilling file, which ensures all pre and post drilling tasks are completed and details the proposed field activities (Attachment 1). The purpose of the drilling file is to facilitate efficient transfer of information and responsibility from the Project Manager (PM) to the Field Geologist and back to the PM upon completion of work. The drilling file will include the following information:

1. Copies of the workplan, approval letter, access agreements, and encroachment and drilling permits
2. USA and owner/tenant clearances
3. Order of work
4. List of supplies necessary for the installation
5. Timeline, budget, and allocation of resources
6. Site safety and health plan specifying personal protection equipment (PPE) anticipated for the project

The Project Manager establishes and ensures task due dates are met. The Field Geologist will direct the order of work and is ultimately responsible for the collection and recording of all field data.

Mobilization and Site Arrival

Mobilization and site arrival covers the assembling of equipment and crew necessary for a particular project through implementation of the workplan at the project site.

1. Verify that equipment and supplies are present. Load drill rig or Geoprobe as applicable
2. Travel to site and notify site owner/operator of start of work
3. Field Geologist will hold tailgate safety meeting and complete a Field Safety Meeting form (Attachment 2)
4. Set up orange cones and "Closed Sidewalk" signs, as appropriate, and secure work area
5. Establish decontamination station, as appropriate

The Field Geologist is responsible for briefing the crew on relevant safety measures during the tailgate safety meeting. This shall take place on the first day of a project, whenever safety conditions change, when new crew members start work on the project, and at intervals of 10 days for long-term continuous projects.

Demobilization

Demobilization consists primarily of returning the drill rig, Geoprobe, support vehicle, and any other equipment used in the course of a project back to pre-implementation condition. The Laboratory Manager or Vice President of Operations shall be notified of any non-disposable equipment lost or damaged during a project. Post implementation elements of the drilling file shall be completed by the Field Geologist and returned to the Project Manager when fieldwork for that phase of the project has been completed. The following shall be added to the drilling file prior to returning it to the Project Manager:

1. Boring and well construction logs
2. Field notes and drawings
3. Equipment and supply billing forms
4. Completed chain-of-custody for analytical laboratory samples
5. Brief written summary of work performed
6. Two copies of the Field Safety Meeting forms; original to the safety officer and one copy to the Project Manager

GENERAL METHODOLOGIES – DRILLING

The following descriptions of work methods cover general tasks associated with drilling and sample collection.

Decontamination

The majority of projects will not require the use of multiple decontamination zones. Separate wash and rinse tubs are adequate for most projects. The Project Manager will indicate in the order of work section of the drilling file if additional decontamination is required.

Sampling equipment will be decontaminated using an Alconox detergent spray with a clean water rinse. Drill bits and rods, augers, and rig tools shall be pressure washed, steam cleaned, or scrubbed with the Alconox and rinsed before and after use. Alconox and clean rinse water will be pumped through each low flow submersible pump prior to its use. Down-hole equipment shall never be lubricated with petroleum-based lubricants.

Waste Storage and Characterization

Storage

1. Soil cuttings will be immediately secured in DOT-approved 55-gallon steel drums, sealed, and marked according to contents, boring of origin, and date of first accumulation, or may be added to an existing stockpile as approved by the Project Manager.

2. Purge water and equipment rinsate will be immediately secured in DOT-approved 55-gallon steel drums, sealed, and marked according to contents, boring of origin, and date of first accumulation.

3. Soil and water storage drums shall only be stored on-site, in a secure location provided by the client.

4. Free-phase gasoline or other hazardous material will be double contained in accordance with 40 CFR 264.175 (1993) in a secure location on-site, provided by the client.

5. Storage of soil known or suspected to qualify as designated or hazardous waste shall conform to the requirements of the Oversight Agency. At a minimum, soil shall be stockpiled on 10-mil PVC sheeting and shall be securely covered with 10-mil sheeting during wet weather periods.

Characterization

Characterization samples will be collected from each drum of wastewater, with methods appropriate for the necessary tests. Samples will be collected using a disposable bailer from the center of the water in the drum.

Samples from soil drums shall be composited by the laboratory in a ratio of 4 drums per 1 sample for analysis. Samples will be collected out of the approximate center of the soil in the drum. However, sampling technique will depend on the required analyses.

Borehole Logging

A complete log will be maintained when soils are encountered during drilling operations (Attachment 3). A State of California Registered Geologist will review the completed log. Soils will be classified in accordance with ASTM D-2488 (Standard Practice for Description and Identification of Soils [Visual-Manual Procedure]). The Field Geologist will record the following data in the log:

1. Based on auger cuttings or soil samples, record visual-manual estimate of grain size percentages (sand, gravel, silt, clay) and describe the soil texture according ASTM D-2488.

2. Record color (Munsell), moisture, density, plasticity, and percent organics.

3. Note any hydrocarbon odor, staining, or sheen.

4. Record depth(s) to saturated soil(s).

5. Record Photoionization Detector (PID) results from bagged grab samples, if applicable.

6. If collecting samples by split-spoon, record SPT blow counts for every 0.5-foot penetration of the split-spoon sampler, driven by a standard 140-pound weight falling a standard distance.

7. Sampling depth(s) and methodologies.

8. Identify samples by sample ID (project number-boring number-depth-matrix), field point name (project number-boring number), and date.

9. Record monitoring well construction specifications or closure date and sealing material(s) for temporary borings.

SAMPLE COLLECTION AND HANDLING

Refer to the Workplan and drilling file for the analytical suite, and to the laboratory for appropriate sample containers.

Surface Water

1. Submerge a clean stainless steel dipper (or other suitable device) with minimal surface disturbance, allow the device to fill slowly and continuously, and retrieve the dipper/device from the surface water with minimal disturbance.

2. Remove the cap from the appropriate sample bottle provided by the laboratory and slightly tilt the mouth of the bottle below the dipper/device edge. Empty the dipper/device slowly, allowing the sample stream to flow gently down the inside of the bottle with minimal entry turbulence. Check that a Teflon septum is present in the cap, if required. Secure the cap tightly. When filling VOAs, ensure that no air is trapped inside the bottle by inverting and tapping. If any bubbles are observed, repeat the procedure.

3. Label the sample bottle with an appropriate sample tag. Be sure to label the tag carefully, legibly and clearly, addressing all the categories. Record sample information in field notes and complete a chain-of-custody form (Attachment 4).

4. Place the properly labeled sample bottle in a cooler maintained at 4°C throughout the sampling and transportation period.

Groundwater

General procedures to be followed for sampling groundwater from a cased boring or hydropunch or screen point sampler:

1. Slowly lower bailer or pump into casing, do not drop.

2. Allow bailer or pump to fill.

3. Retrieve bailer or begin pumping.

4. Remove the cap from the appropriate sample bottle provided by the laboratory and slightly tilt the mouth of the bottle below the bailer or pump outlet. Fill the sample container slowly, allowing the sample stream to flow gently down the side of the bottle with minimal entry turbulence. Check that a Teflon septum is present in the cap, if required. Secure the cap tightly. When filling VOAs, ensure that no air is trapped inside the bottle by inverting and tapping. If any bubbles are observed, repeat the procedure.

5. Place the properly labeled sample bottle in a cooler maintained at 4°C throughout the sampling and transportation period.

Soils

1. Place clean sample container on clean surface.

2. Place soil into appropriate sample container.

3. For samples contained in a brass tube, cap each end with Teflon tape or aluminum foil and a plastic cap.

4. Place the properly labeled sample container in a cooler maintained at 4°C throughout the sampling and transportation period.

Sample Coordination

Review chain-of-custody and submit samples to laboratory upon return from the field. Alternate arrangements shall be made if sample holding times will expire before fieldwork is completed. Soil samples do not require additional packaging during transport; however, liquid samples should be packaged securely.

DRILLING FOR SUBSURFACE INVESTIGATION AND MONITORING WELL INSTALLATION

Refer to the drilling file for drilling method(s), sampling depth(s), sampling method(s), and monitoring well construction specifications. The drill rig operator shall possess, or work for a company that possesses, a valid, current C-57 Well Driller's License. Installation, construction, and closure of borings and monitoring wells shall be in accordance with Bulletins 74-81 and 74-90, California. Variations from the California Well Standards must be authorized by the Oversight Agency, in advance. Rotary and direct push drilling procedures are discussed. General borehole logging and sample handling procedures are outlined in the General Methodologies Section.

Rotary Drilling

Rotary drilling uses flighted augers to remove soil from a borehole. The purpose is to advance a borehole to a designated depth from which a sampler will be utilized to collect soil or groundwater samples, or install a casing to hold a borehole open. Augers are typically constructed in 5-foot lengths of heavy-duty steel that connect together. Caution is advised when lifting heavy equipment. Hollow stem augers are open in the middle and solid are not. Solid flight augers are generally used in cohesive soils. Non-cohesive soils require the use of hollow stem augers.

Solid Flight Augers
Augers are advanced to the required depth and removed, then a soil sampler or casing is lowered into in the borehole.

Soil Sampling
A soil sampler connected to drill rod(s) is advanced to the specified depth and retrieved. A steel split-spoon or push tube is used to collect soil samples (Figure 1).

1. Lift augers out of borehole and insert clean split-spoon or push tube sampler.
2. The split spoon is attached to heavy-duty drill-rods and the push tube to light weight rods.
3. Lower the assembly into the borehole.
4. Attach a slide hammer to the rods.
5. Without lifting the rods, advance the sampler to the specified depth.
6. Retract the rods to the starting depth and disconnect the slide hammer.
7. Attach a lifting nipple to the rods and retract the sampler.
8. Remove the soil from the sampler in a clean work area.

9. Follow soil sample collection and handling procedures.

Groundwater Sampling

A well screen is installed to the specified depth for the retrieval of groundwater grab samples and recording of depth to water measurements (Figure 2). A bailer or bottom tubing check ball pump is typically used to collect groundwater samples.

Temporary Screening Well Construction

1. Using new clean PVC pipe, saw-cut slots over the desired screen interval (typically 5 feet).

2. Place a cap on each end.

3. With the slotted end down, insert pipe to bottom of borehole.

4. If the boring is to be left overnight, or if it may receive surface runoff, place a bridge to a depth of 1 foot around the pipe followed by a bentonite seal.

Groundwater Collection

1. Slowly lower the specified sampling device to approximately one foot above the bottom of the casing to minimize the amount of sediment collected in the groundwater sample.

2. Follow groundwater sample handling and collection procedures.

Hollow Stem Augers

Hollow Stem Augers are used to prevent a borehole from collapsing during sample collection or well installation. Augers are advanced to the required depth and the drill rods are removed. A soil or hydropunch sampler is then be lowered down the hollow augers. When a continuous soil core is desired, a core barrel positioned inside the augers is simultaneously advanced to the specified depth. The augers function as a centralizer during placement of well casing and as a tremmie pipe during the placement of the annular materials.

Soil Sampling

A soil sampler connected to drill rod(s) is lowered through the augers or advanced with the augers to the specified depth and retrieved (Figure 3).

1. Attach a clean push tube or split-spoon to the drill rods.

2. The push tube is attached to light weight rods and the split spoon to heavy-duty drill rods.

3. Lower the assembly into the borehole through the hollow stem augers.

4. Attach a slide hammer to the drill rods.

5. Without lifting the rods, advance the sampler to the specified depth.

6. Retract the rods to the starting depth and disconnect the slide hammer.

7. Attach a lifting nipple to the rods and retract the sampler.

8. In a clean work area remove the soil from the sampler.

9. Follow soil sample handling and collection procedures.

Hydropunch Sampling

A groundwater sampler connected to drill rod(s) is lowered through the augers, advanced to the specified depth and retracted to expose the sampler to the aquifer (Figure 4).

1. Assemble a clean hydropunch sampler with new slotted casing and expendable drive point. Check and replace damaged o-ring seals. Position a gouch tube over the shoe and drive point ensuring the point remains tightly against the shoe.

2. Attach the hydropunch sampler to the drill rods. Teflon tape should be placed on the threads.

3. Lower the assembly into the borehole through the hollow stem augers.

4. Attach the slide hammer to the drive rods.

5. Without lifting the drive rods, advance the assembly to the specified depth.

6. Retract the drive rods to the specified depth to open the sampler, secure the drive rods, and disconnect the slide hammer.

7. Follow groundwater sample handling and collection procedures.

8. Remove the drive rods and hydropunch assembly. The casing and drive point remain in the borehole.

Monitoring Well Installation

Augers are advanced to the required depth and the drill rods are removed. The augers are used to allow proper placement of the well casing and annular materials. Monitoring well construction specifications are outlined in the workplan and drilling file. Well installation can be a tedious process with several potential problems. The licensed well driller ultimately decides how the well installation will proceed.

1. Assemble a new well casing (screen and blank pipe) with a locking cap and end cap.

2. Lower assembly into the borehole through the hollow stem augers.

3. Pour sand inside the augers, according to the licensed well driller's instructions.

4. Once the sand pack is in place, place the annular seal according to the licensed well driller's instructions.

5. Complete the well by setting an access box in a concrete apron.

6. Tag or label the well with the number.

Direct Push

Direct push uses a pneumatic hammer and hydraulic piston to advance soil and groundwater samplers or hollow drive rods to hold the borehole open during monitoring well installation. Rods are constructed in 5-foot lengths of heavy-duty steel that connect together. Caution is advised when lifting heavy rods.

Soil Sampling (Macrocore)
A piston rod soil sampler (Macrocore) connected to the lead drive rod is advanced to the specified depth, the piston rod is removed, and the sampler is advanced to the appropriate depth and retrieved (Figure 6).

Sampler Assembly, Advancement, and Sample Collection

1. Assemble a clean Macrocore as specified. Check and replace damaged O-ring seals.
2. Attach the Macrocore to the drive rods.
3. Advance the Macrocore to the specified depth.
4. Remove the piston rod.
5. Advance the Macrocore through the desired sampling interval (4 feet or less).
6. Retract the sampler.
7. In a clean work area remove the core from the sampler.
8. Cut open the plastic liner.
9. Follow soil sample handling and collection procedures.

Groundwater Sampling (Screen Point Sampler)
A screen-point sampler connected to drive rod(s) is advanced to the specified depth (Figure 7). The sheath is retracted to expose the screen and a bottom tubing check ball pump or peristaltic pump is used to collect groundwater samples.

Screen Point Sampler Assembly and Advancement

1. Assemble a clean screen point sampler with new expendable drive point. Check and replace damaged O-ring seals.
2. Attach the sampler to the drive rods with new O-rings placed on the top of each rod.
3. Advance the sampler to the specified depth.

4. Retract the drive rods to expose the screen (4 feet or less).

Groundwater Collection

1. Slowly lower the specified sampling device to the bottom of the screen point sampler.

2. Follow groundwater sample handling and collection procedures.

3. Remove the drill rods and sampler assembly.

4. The drive point remains in the borehole.

Monitoring Well Installation

3.25-inch diameter hollow drive rods are advanced to the required depth with an expendable tip. The hollow rods are used to allow proper placement of the well casing and annular materials. Monitoring well installation specifications are outlined in the workplan and drilling file. Well installation can be a tenuous process with several potential problems. The licensed well driller ultimately decides how the well construction will proceed.

1. Assemble a new well casing (screen and blank pipe) with a locking cap and end cap.

2. Lower assembly into the drive rods.

3. Pour sand inside the rods, according to the licensed well driller's instructions.

4. Once the sand pack is in place, place the annular seal according to the licensed well driller's instructions.

5. Complete the well by setting an access box in a concrete apron.

6. Tag or label the well with the number.

Hand Auger

A hand auger uses an auger bucket and connecting rods to remove soil from a borehole for the purpose for advancing a boring to a sampling depth. A sampler is then used to collect soil samples or a casing is installed to hold the borehole open. 1-inch diameter monitoring wells can also be installed. Buckets are typically one foot long. Connecting rods are typically constructed in 4-foot lengths of steel. A hand auger is used when drill rig access is limited, utilities are too close, or the total depth is generally less than 5 feet.

Soil Sampling

A steel push tube is used to collect soil samples (Figure 9). The sampler is connected to drive rod(s) and is advanced to the specified depth using a slide hammer. Sampler is

retrieved by hammering in the opposite direction. Refer to soil sample collection and handling procedures.

Groundwater Sampling
A slotted casing is installed to the specified depth for the retrieval of groundwater grab samples and recording of depth-to-water measurements (Figure 10). A bailer or peristaltic pump is typically used to collect groundwater samples. Refer to groundwater sample collection and handling procedures.

Monitoring Well Construction
Auger the borehole to the required depth (Figure 11). Monitoring well construction specifications are outlined in the workplan and drilling file.

1. Assemble a new well casing (screen and blank pipe) with a locking cap and end cap.

2. Lower assembly into the borehole.

3. Pour sand and place the annular seal according to the well driller's instructions.

4. Complete the well by setting an access box in a concrete apron.

5. Tag or label the well with the number.

MONITORING WELL DEVELOPMENT AND SURVEYING

Monitoring Well Development

Following installation of a monitoring well it must be developed before it is brought into service. Developing a well removes sediment in the sand pack and on the borehole wall, and maximizes recharge to the well. Monitoring wells are to be developed prior to setting the seal or a minimum of 72 hours after setting the seal, according to procedures generally described in 40 CFR 264.175.

1. Measure and record total depth of boring and depth-to-water for each well to be developed. Depth-to-water will be measured with an electronic depth sensor or engineers tape (0.01-foot increments) and water sensitive paste. Measurements will be recorded to the nearest 0.01-foot from the top of casing (TOC).

2. Develop wells by slowly inserting and withdrawing an appropriately sized surge block through the entire water column without rising above the water surface. This is *surging* the wells.

3. After 5 minutes quickly remove the surge block and insert a submersible pump with the intake no less than 2 feet off the bottom. If well diameter is too small for a submersible pump, a bailer should be used.

4. Purge water from the well at a rate of 1 to 2 gallons per minute [gpm], until clarity is reached. This is *purging* the well. Surging and purging may be repeated as necessary, but should be progressively gentler.

5. Complete a monitoring well field worksheet (Attachment 5).

6. A newly developed well is to be sampled no sooner that 24 hours after development. Refer to SOP No. 2 for monitoring well sampling procedures.

Wellhead Surveying

The reference elevation with respect to NAVD-88 for the top of casing (TOC) for each monitoring well or temporary screening well will be determined by survey to the nearest 0.01 foot. Surveys are to be performed under the supervision of a licensed land surveyor with the appropriate equipment and operated and calibrated in accordance with the manufacturer's recommended procedures. In all cases, wells shall be located horizontally under the supervision of a licensed land surveyor to the State Plane Coordinate System.

REFERENCES

ASTM D-2488
40 CFR 264.175
California Well Standards Bulletin 74-81
California Well Standards Bulletin 74-90

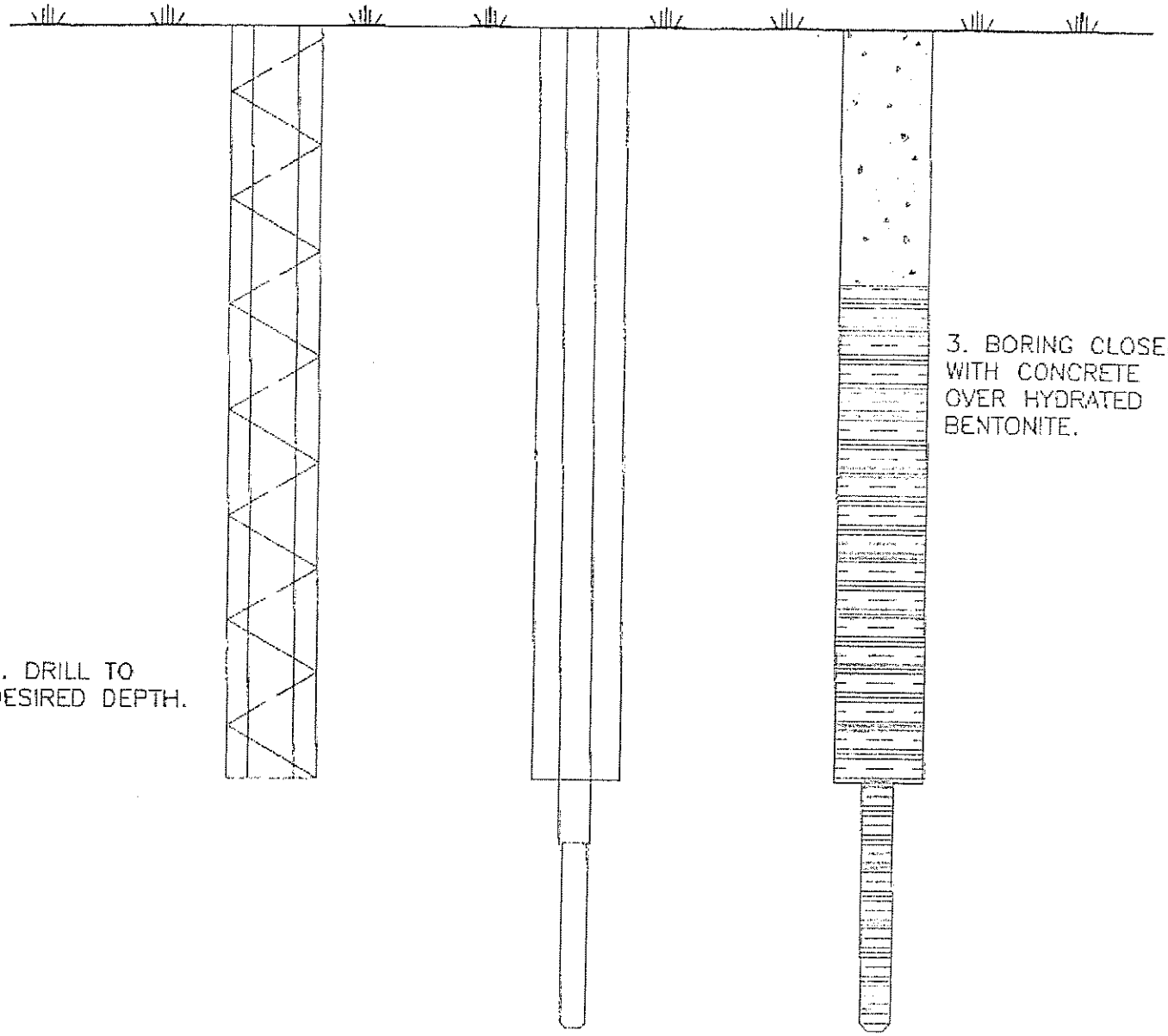
LIST OF FIGURES

LIST OF ATTACHMENTS

FIGURES

LACO ASSOCIATES
CONSULTING ENGINEERS
21 W 4TH ST. EUREKA, CA 95501 (707)443-5054

PROJECT	STANDARD OPERATING PROCEDURES	BY BAB	FIGURE 1
CLIENT		DATE 8/21/02	
LOCATION		CHECK	JOB NO.
	TYPICAL SOLID FLIGHT AUGER SOIL SAMPLING	SCALE NTS	

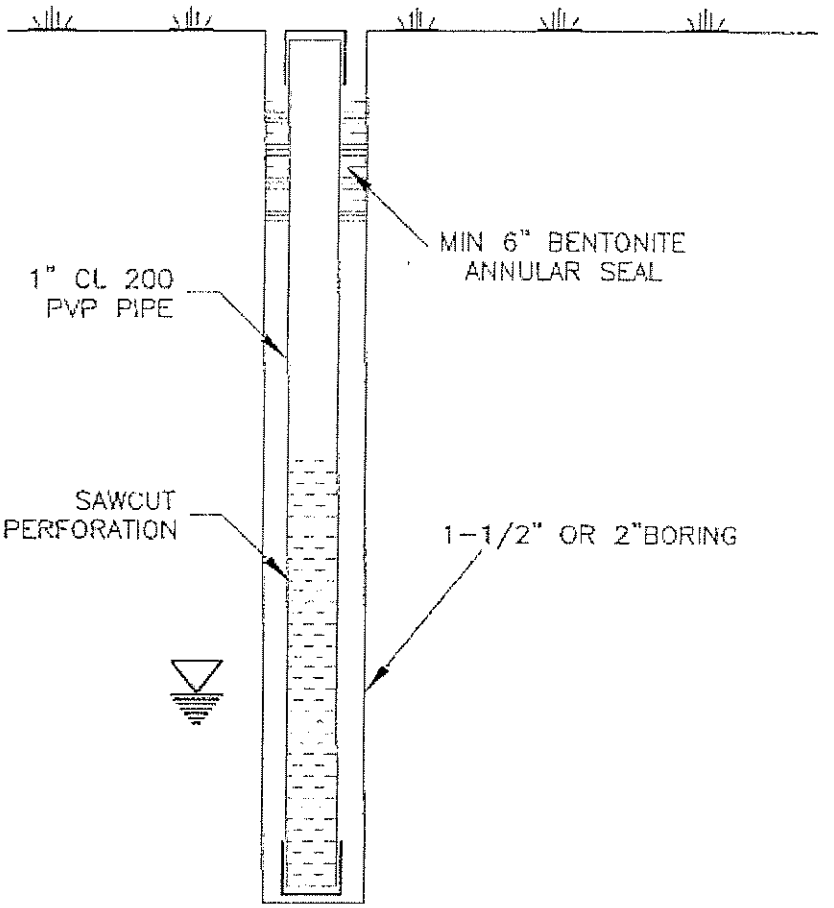


1. DRILL TO DESIRED DEPTH.

2. REMOVE AUGER AND DRIVE SAMPLER INTO FORMATION, THEN REMOVE SAMPLER.

3. BORING CLOSED WITH CONCRETE OVER HYDRATED BENTONITE.

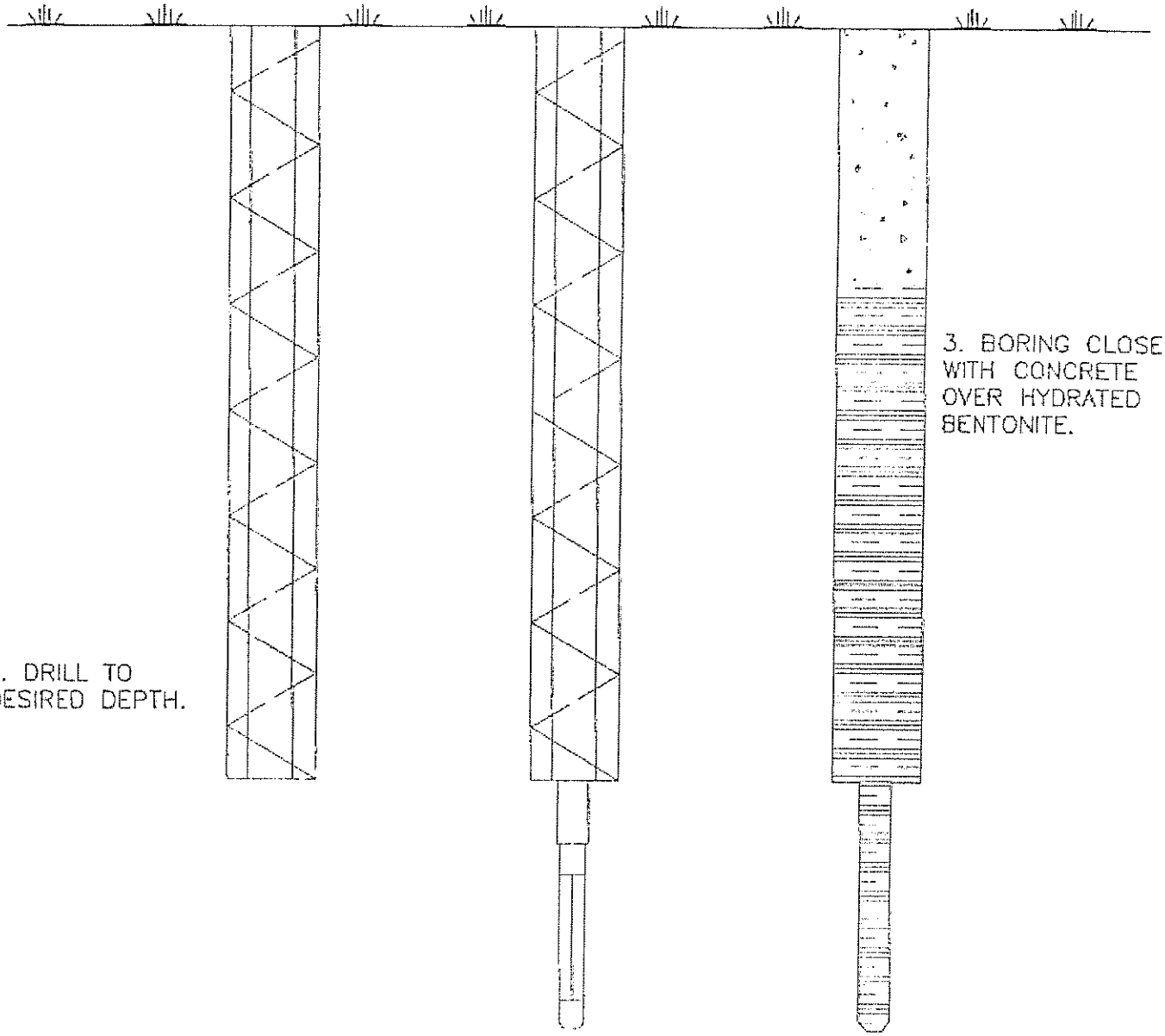
LACO ASSOCIATES CONSULTING ENGINEERS 21 W 4TH ST. EUREKA, CA 95501 (707)443-5054	PROJECT STANDARD OPERATING PROCEDURES	BY BAB	FIGURE 2
	CLIENT	DATE 8/21/02	
	LOCATION	CHECK	JOB NO.
	TYPICAL SOLID FLIGHT AUGER GROUNDWATER SAMPLING	SCALE NTS	



A. SCREENING WELL (NO WELLPOINT)

USED IN AREAS FREE OF SURFACE CONTAMINATION OR OTHER CONTAMINATION NOT CURRENTLY IN CONTACT WITH GROUNDWATER CLOSED WITHIN 72 HOURS.

LACO ASSOCIATES CONSULTING ENGINEERS 21 W 4TH ST. EUREKA, CA 95501 (707)443-5054	PROJECT STANDARD OPERATING PROCEDURES	BY BAB	FIGURE 3
	CLIENT	DATE 8/21/02	
	LOCATION	CHECK	JOB NO.
	TYPICAL HOLLOW STEM AUGER SOIL SAMPLING	SCALE NTS	

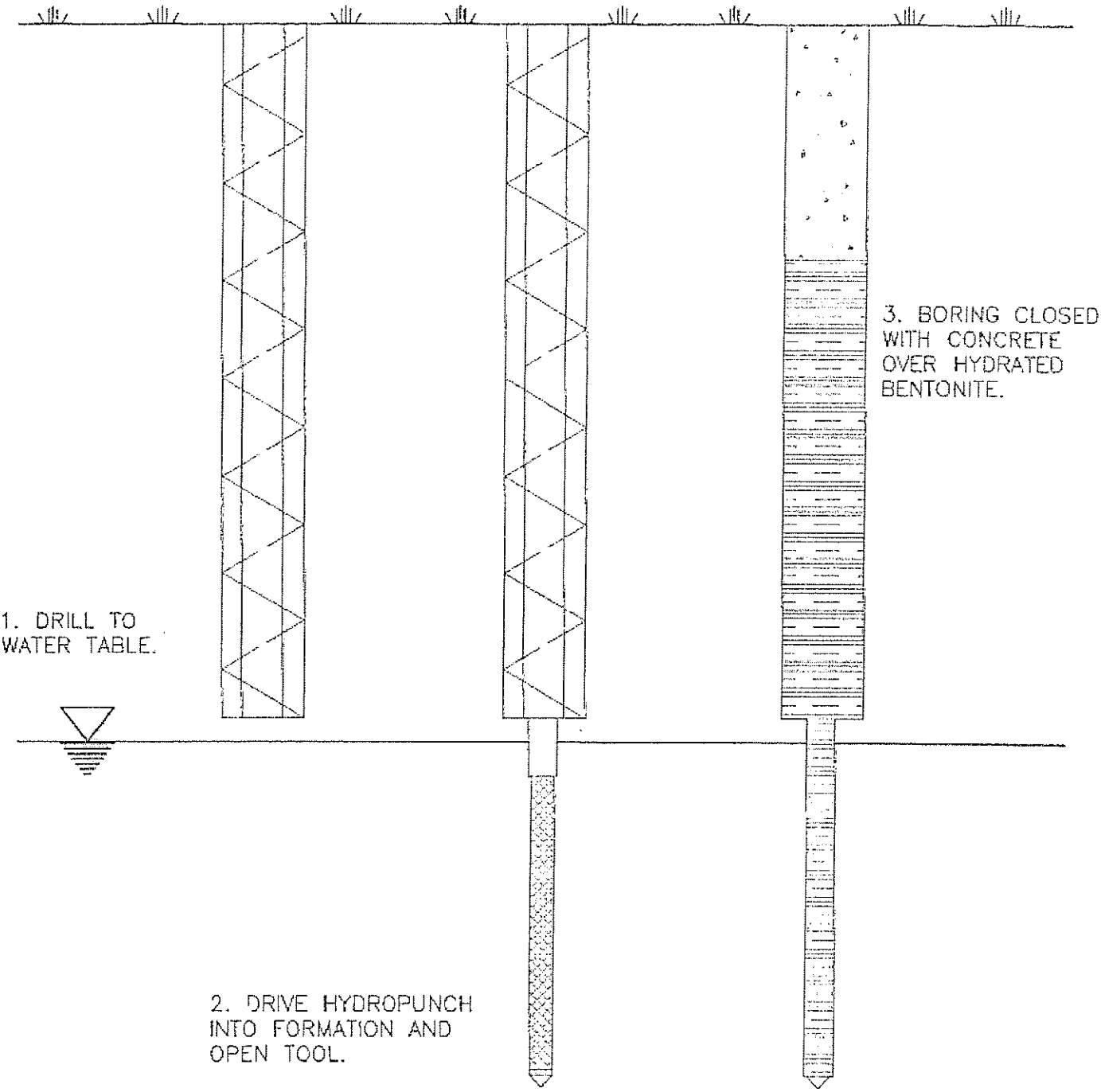


1. DRILL TO DESIRED DEPTH.

2. DRIVE SAMPLER INTO FORMATION, THEN REMOVER SAMPLER.

3. BORING CLOSED WITH CONCRETE OVER HYDRATED BENTONITE.

LACO ASSOCIATES CONSULTING ENGINEERS 21 W 4TH ST. EUREKA, CA 95501 (707)443-5054	PROJECT STANDARD OPERATING PROCEDURES	BY BAB	FIGURE 4
	CLIENT	DATE 8/21/02	
	LOCATION	CHECK	JOB NO.
	TYPICAL HYDROPUNCH BORING	SCALE NTS	



Aug 22,2002 - 10:16am
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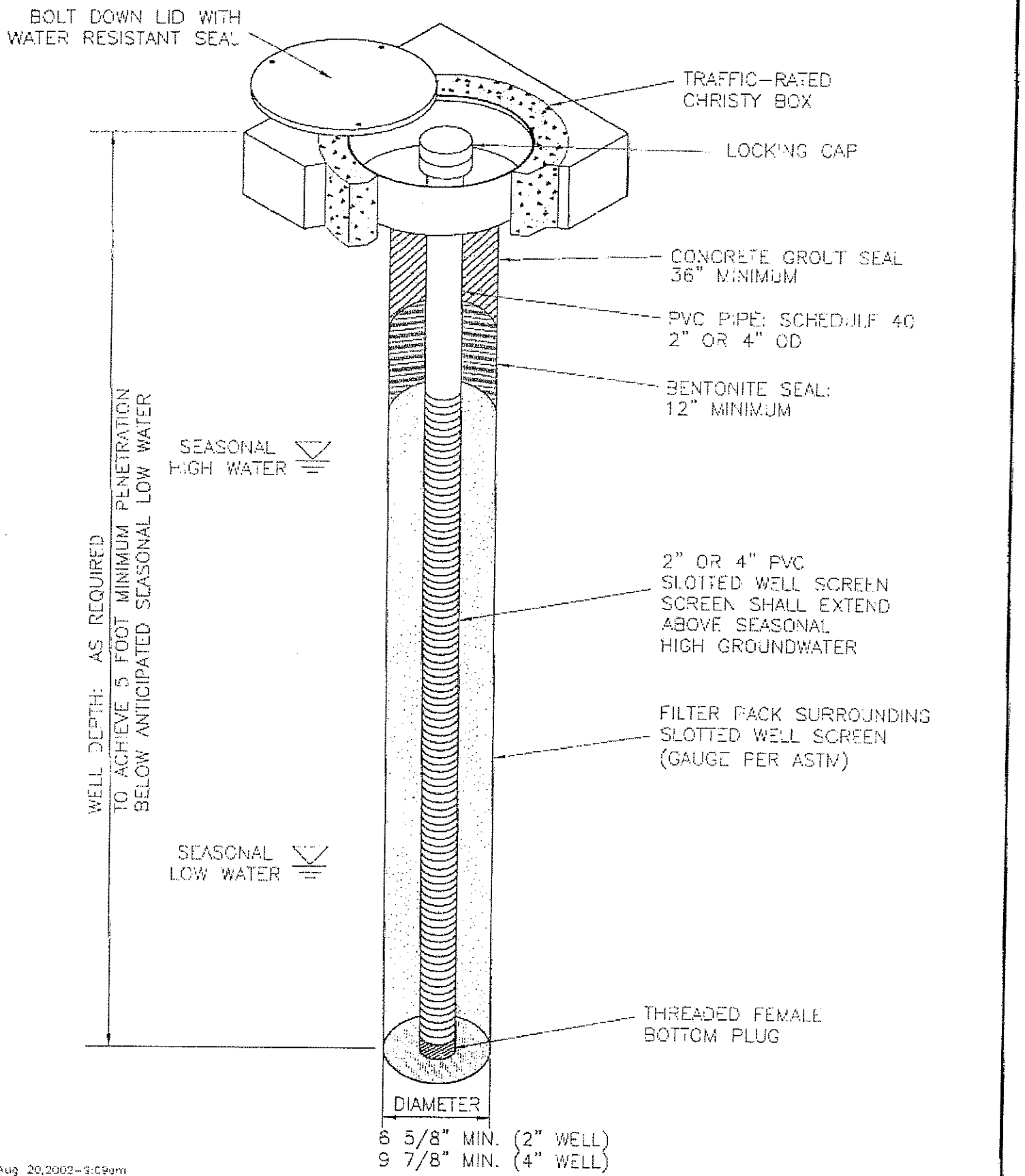
LACO ASSOCIATES CONSULTING ENGINEERS 21 W 4TH ST. EUREKA, CA 95501 (707)443-5054	PROJECT STANDARD OPERATING PROCEDURES	BY BAB	FIGURE 5
	CLIENT	DATE 8/19/02	
	LOCATION	CHECK	JOB NO.
	TYPICAL MONITORING WELL	SCALE NTS	



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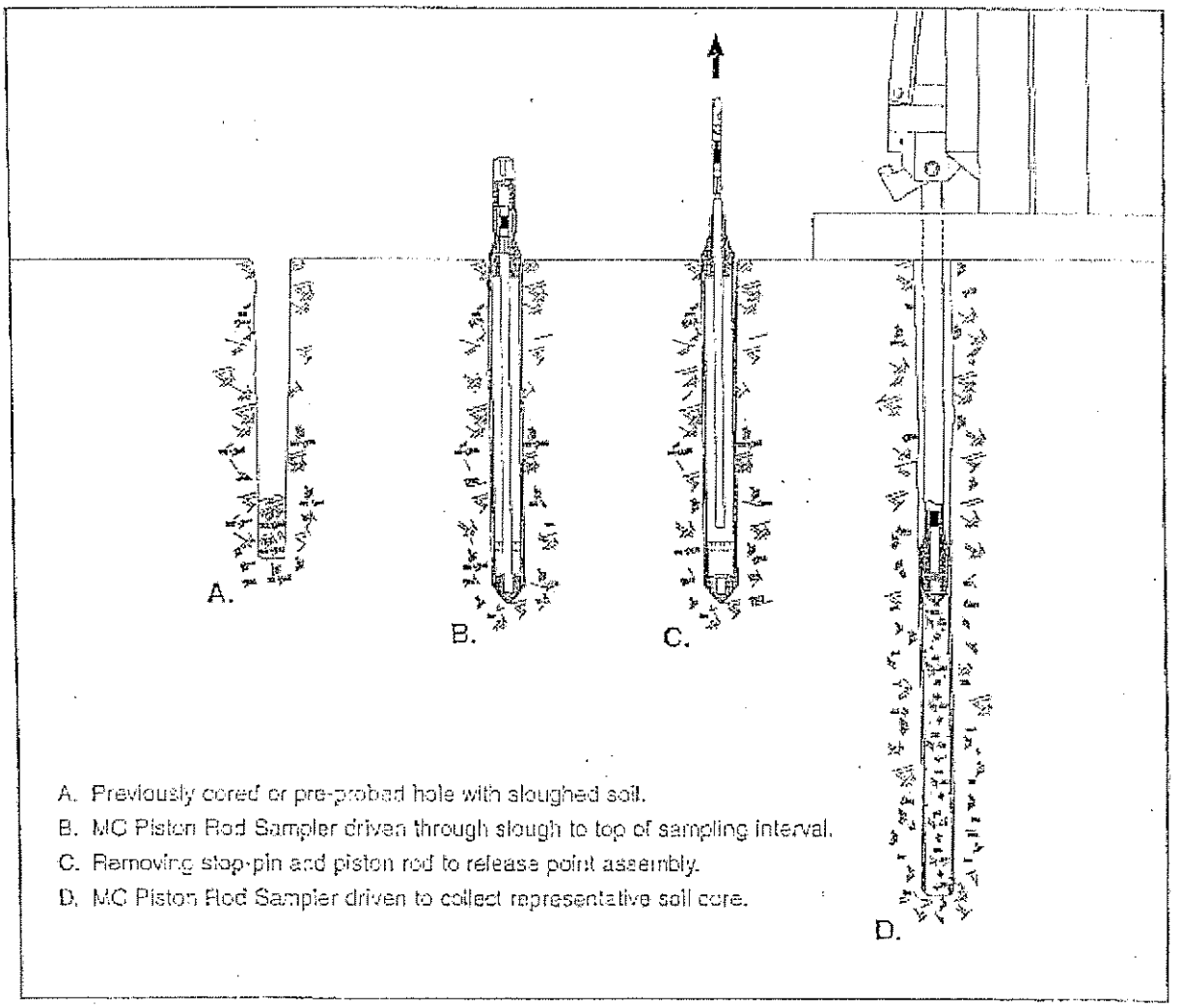
LACO ASSOCIATES
CONSULTING ENGINEERS
21 W 4TH ST. EUREKA, CA 95501 (707)443-5054

PROJECT STANDARD OPERATING PROCEDURES	BY BAB	FIGURE 6
CLIENT	DATE 8/21/02	
LOCATION	CHECK	JOB NO.
PISTON ROD SOIL SAMPLING	SCALE NTS	

GEOPROBE MACRO-CORE® SOIL SAMPLER

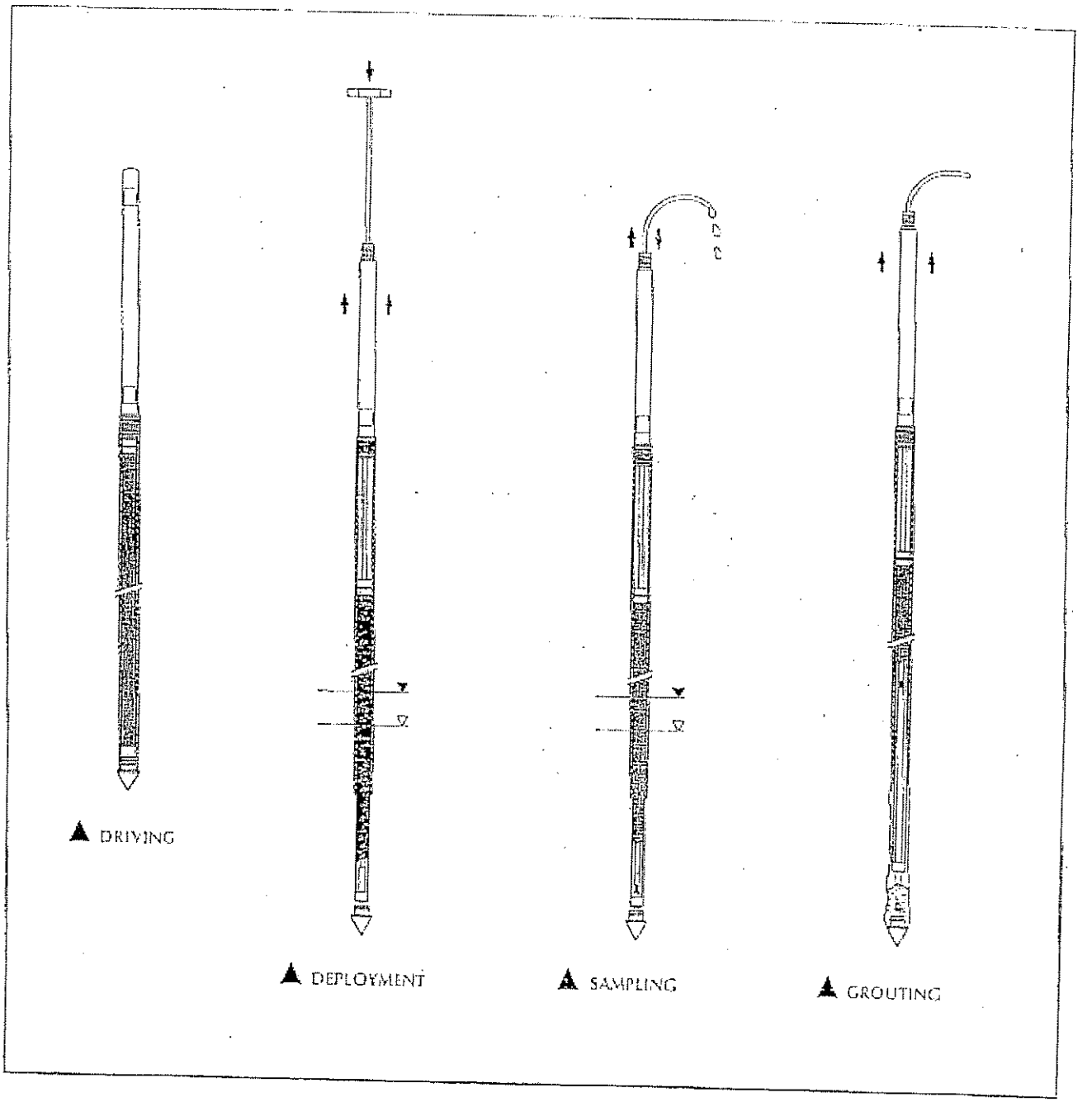


A. Previously cored or pre-probed hole with sloughed soil.
B. MC Piston Rod Sampler driven through slough to top of sampling interval.
C. Removing stop-pin and piston rod to release point assembly.
D. MC Piston Rod Sampler driven to collect representative soil core.

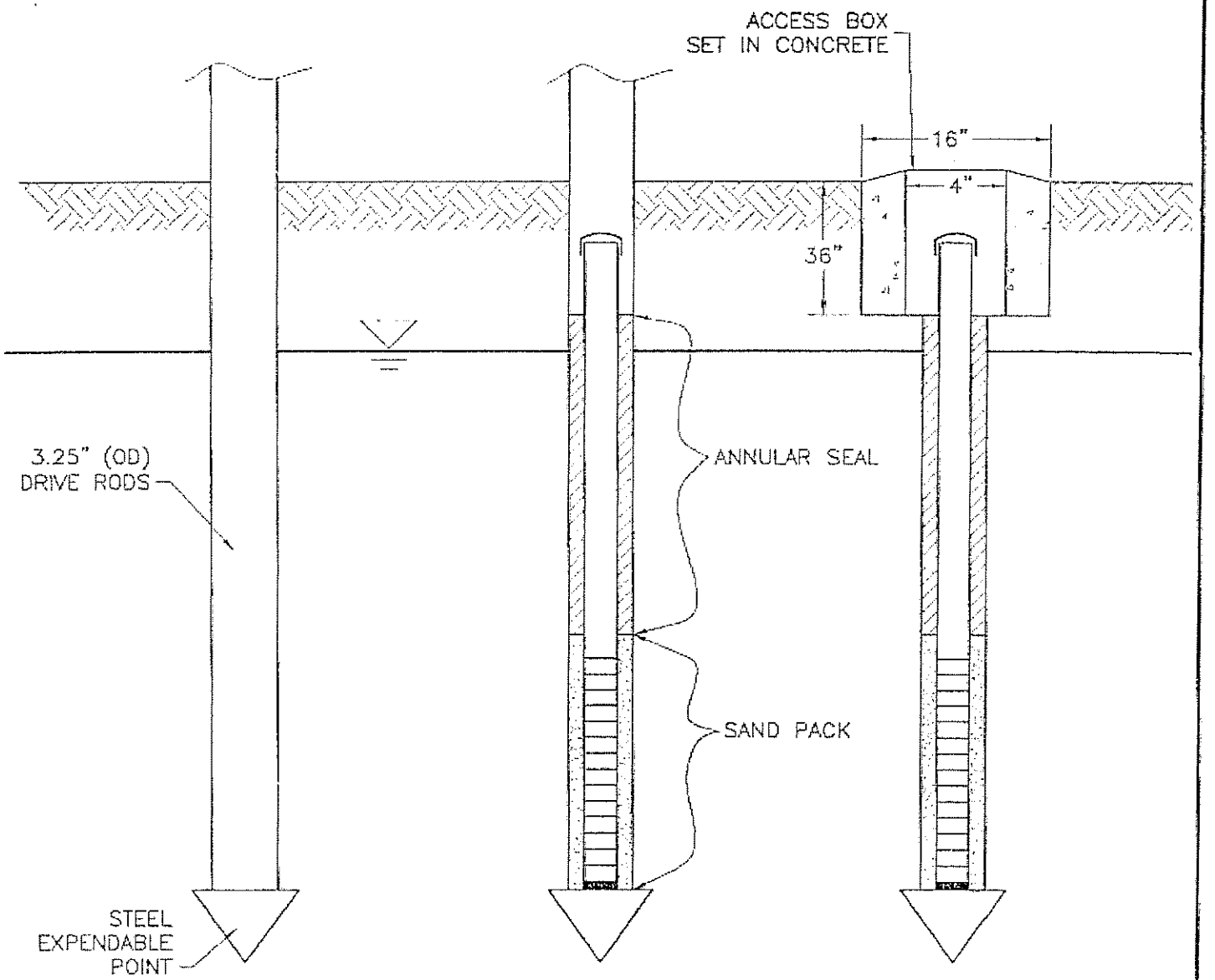
LACO ASSOCIATES
CONSULTING ENGINEERS
21 W 4TH ST. EUREKA, CA 95501 (707)443-5054

PROJECT: STANDARD OPERATING PROCEDURES	BY: BAB	FIGURE: 7
CLIENT:	DATE: 8/21/02	
LOCATION:	CHECK:	JOB NO.
GROUNDWATER SAMPLING	SCALE: NTS	

GEOPROBE® SCREEN POINT 16 GROUNDWATER SAMPLERS



LACO ASSOCIATES CONSULTING ENGINEERS 21 W 4TH ST. EUREKA, CA 95501 (707)443-5054	PROJECT STANDARD OPERATING PROCEDURES	BY BAB	FIGURE 8
	CLIENT	DATE 5/28/02	
	LOCATION	CHECK	JOB NO.
	DIRECT PUSH MONITORING WELL	SCALE NTS	

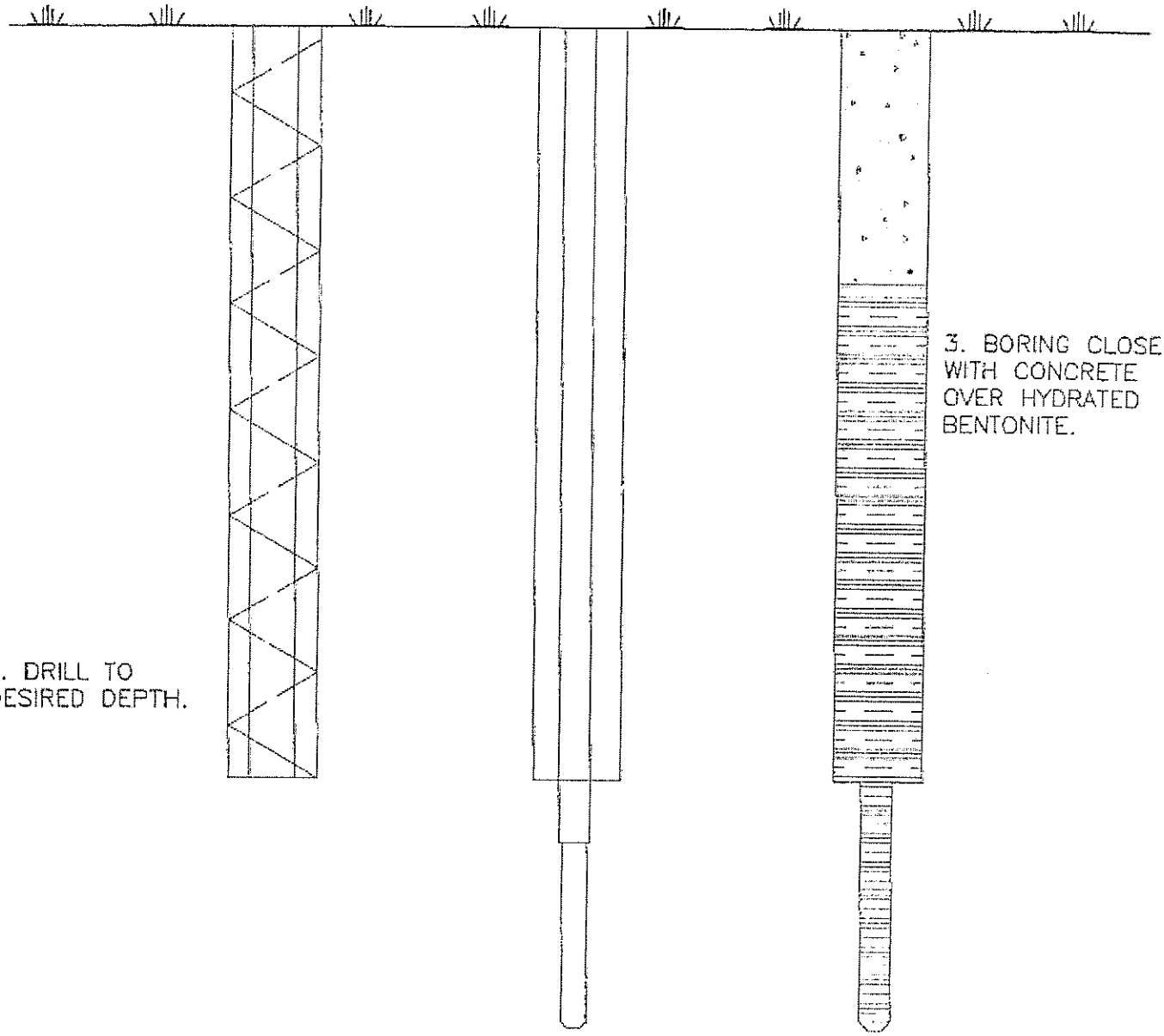


1. DRIVE SEALED DUAL TUBE TO TOTAL DEPTH

2. SET 1.5" PVC SCREEN & BLANK PIPE & ANNULAR MATERIALS, EXTRACT RODS

3. SET ACCESS BOX IN CONCRETE 36"x16"

LACO ASSOCIATES CONSULTING ENGINEERS 21 W 4TH ST. EUREKA, CA 95501 (707)443-5054	PROJECT STANDARD OPERATING PROCEDURES	BY BAB	FIGURE 9
	CLIENT	DATE 8/21/02	
	LOCATION	CHECK	JOB NO.
	TYPICAL HAND AUGER SOIL SAMPLING	SCALE NTS	



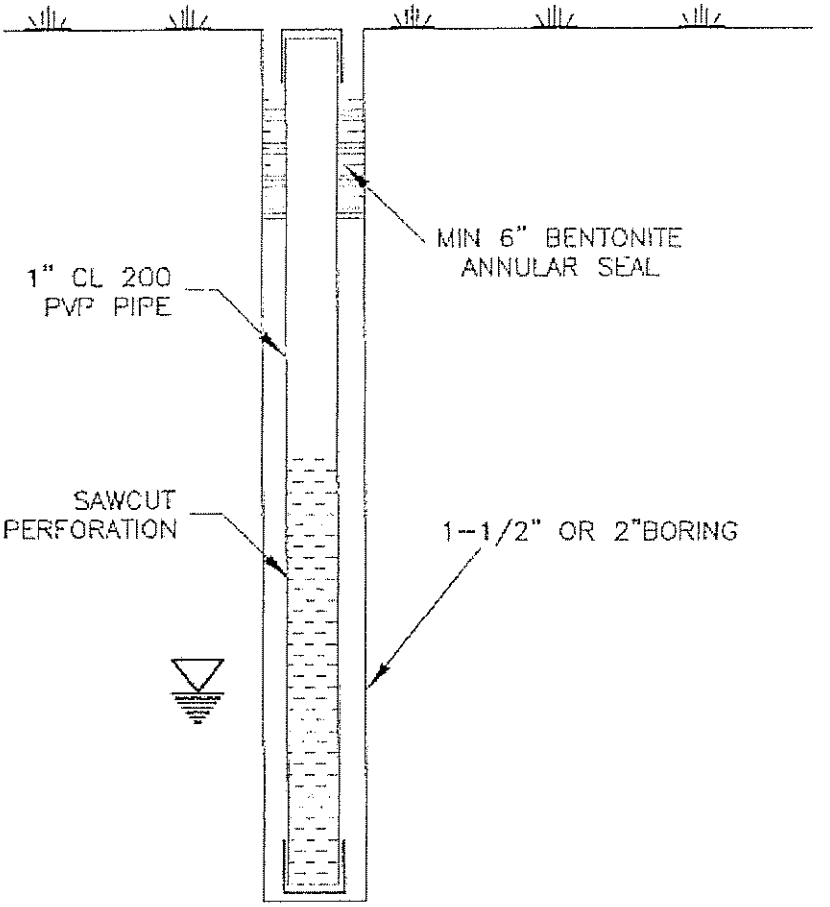
1. DRILL TO DESIRED DEPTH.

2. REMOVE AUGER AND DRIVE SAMPLER INTO FORMATION, THEN REMOVE SAMPLER.

3. BORING CLOSED WITH CONCRETE OVER HYDRATED BENTONITE.

LACO ASSOCIATES
CONSULTING ENGINEERS
21 W 4TH ST. EUREKA, CA 95501 (707)443-5054

PROJECT STANDARD OPERATING PROCEDURES	BY BAB	FIGURE 10
CLIENT	DATE 8/21/02	
LOCATION	CHECK	JOB NO.
TYPICAL HAND AUGER GROUNDWATER SAMPLING	SCALE NTS	

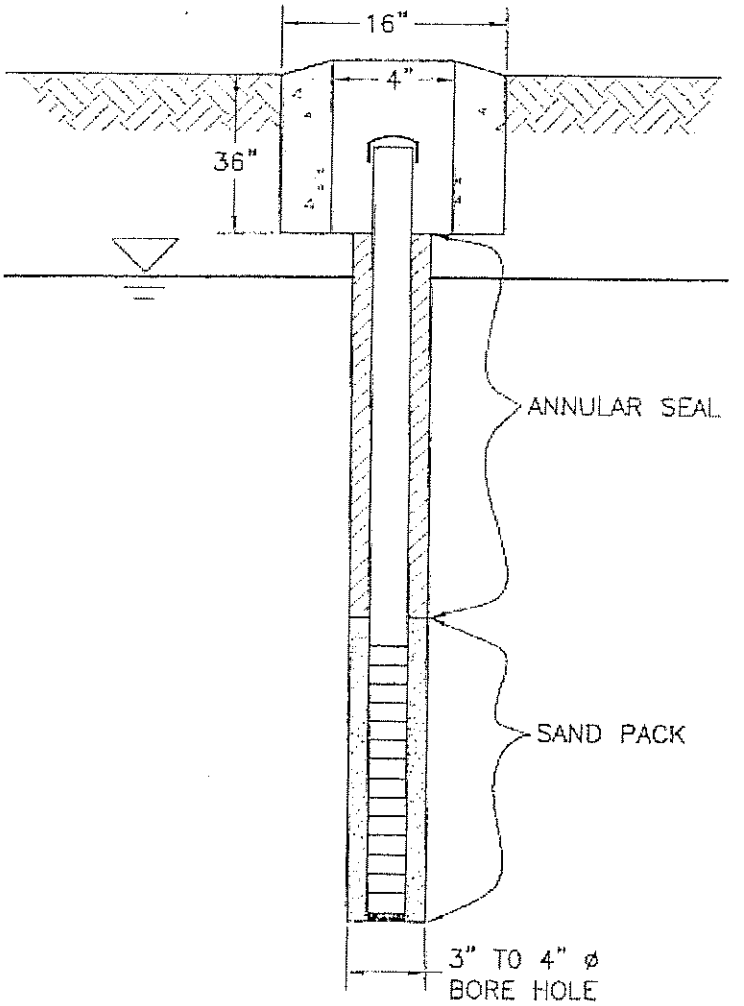


A. SCREENING WELL (NO WELLPOINT)

USED IN AREAS FREE OF SURFACE CONTAMINATION OR OTHER CONTAMINATION NOT CURRENTLY IN CONTACT WITH GROUNDWATER CLOSED WITHIN 72 HOURS.

LACO ASSOCIATES
CONSULTING ENGINEERS
21 W 4TH ST. EUREKA, CA 95501 (707)443-5054

PROJECT: STANDARD OPERATING PROCEDURES	BY: BAB	FIGURE: 11
CLIENT:	DATE: 8/21/02	
LOCATION:	CHECK:	JOB NO:
TYPICAL HAND AUGER MONITORING WELL	SCALE: NTS	



1. HAND AUGER TO DESIRED DEPTH

2. SET 1" TO 1.5" PVC SCREEN & BLANK PIPE & ANNULAR MATERIALS.

3. SET ACCESS BOX IN CONCRETE 36"x16"

ATTACHMENTS

Project Name _____ Project Number _____
Project Manager _____ Date initiated _____

Task	Initials	Date		Due Date
			Project Manager (PM)	
			☐ Project initiation, *PM obtains blank drilling file from Drilling Coordinator (DC) (15 to30 days prior to drilling day)*	
40	____	____	☐ Work Plan *reviewed by PM*	
40	____	____	☐ Addenda (where appropriate) *reviewed by PM*	
40	____	____	☐ Regulatory approval letter *reviewed by PM*	
40	____	____	☐ Fund pre approval documents (where appropriate) *reviewed by PM*	
40	____	____	☐ Contact Drilling company for tentative start date (if other than Lake's Well Drilling)	
40	____	____	☐ Initial Preferred field personnel, tentative start work date, budget, order of work (Drilling File Form-1) *created by PM*	
40	____	____	☐ Initial preferred field personnel approval, *approved by Vice President of Operations (VPO)*	
40	____	____	☐ Site Map *obtained by PM with locations of existing and proposed holes indicated*	
40	____	____	☐ Site Safety Plan *obtained by PM*	
40	____	____	☐ PM forwards drilling file to DC	
			Permitting Team	
33	____	____	☐ Drilling permit request, *DC reviews file (8 to 20) days prior to drilling day*	
	____	____	☐ DC forwards drilling file to DC assistant	
			☐ DC Assistant obtains the following forms, *submits a copy to the drilling file and once original is returned, submits it to the drilling file.*	
51	____	____	Private property access agreement ☐ Submitted ☐ Original received and copy to file	
51	____	____	Encroachment permit ☐ Submitted ☐ Original received and copy to file	
33	____	____	Drilling permit application ☐ Submitted ☐ Original received and copy to file	
33	____	____	☐ Site Clearances, (Drilling File Form-2), *site clearance information gathered by DC assistant*	
33	____	____	☐ Parcel Map and list of property owners, (if applicable)	
33	____	____	☐ USA marks, *DC defines USA area on map*	
33	____	____	☐ Drilling file review, *reviewed by DC and forwarded to PM*	
			Project Manager	
40	____	____	☐ Drilling file review for completeness, *reviewed by PM, (5 to 10 days prior to drilling day*	
40	____	____	☐ Final field personnel request, (Drilling File Form-3) *created by PM*	
40	____	____	☐ Final personnel approval, *approved by VPO* (See Drilling File Form-3)	
			Geologist *(5 to 10 days prior to drilling day)*	
40	____	____	☐ Drilling file review, *reviewed by Geologist*	
40	____	____	☐ Meeting-discuss tasks not clearly defined and background information, *Geologist meets with PM*	
40	____	____	☐ Meeting-reconfirmation start date and personnel, *Geologist schedules* meeting with DC, PM, VPO	

Project Name _____ Project Number _____
Project Manager _____ Date initiated _____

Task	Initials	Date		Due Date
			Geologist continued *(5 to 10 days prior to drilling day)*	
51			☐ Notification of work schedule, *Geologist personally notifies by phone and documents,* (See Drilling File Form-2)	
51			☐ Owners	
51			☐ Tenants	
51			☐ Private Property Owners	
51			☐ Public Agencies	
40			☐ Well hardware Est, (Drilling File Form-4), *created by Geologist, given to DC*	
40			☐ Well hardware ordered, (See Drilling File Form-4) *ordered by DC and form returned to Geologist*	
40			☐ Laboratory container order, *ordered by DC*	
33			☐ Schedule of Site Markings, *Geologist arranges for site to be USA marked by field tech*	
33			☐ Site Markings, Field tech marks site, signs and dates site map, submits to PM and geologist *(5 days prior to drilling day)*	
33			☐ Meeting-DC meets with Geologist to discuss USA description of work area	
			Project Manager *(5 days prior to drilling day)*	
33			☐ USA contact and #, *PM calls in ticket and records start work date and time, ticket # and renewal date (5 days prior to drilling)* (See Drilling File Form-2)	
48			☐ Regulatory agency contact, *PM calls regulatory agency with confirmed start date (1 to 2 days prior to drilling day)* (See Drilling File Form-2)	
			Project Manager *(1 day prior to drilling day)*	
40			☐ Drilling file review, *reviewed by PM*	
			Drilling Starts *(Follow SOP #1)*	
			Geologist	
40			☐ Field Notes, *collected by Geologist(5 days after drilling)*	
40			☐ Boring and well construction logs	
40			☐ Field notes and drawings	
40			☐ Equipment and supply billing forms	
40			☐ Chain of Custody for analytical lab samples	
40			☐ Written summary of work performed	
40			☐ Completed site safety form, submit copy to LACO safety officer, (See Drilling File Form-5)	
			Project Manager	
40			☐ Drilling file review, *PM reviews file and distributes appropriate information. (5 days after drilling)*	

LACO ASSOCIATES
CONSULTING ENGINEERS
(707) 443-5054
21 W 4th STREET EUREKA, CA 95501

FIELD SAFETY MEETING

Complete and return to LACO Safety Officer

PROJECT NAME / NUMBER: _____ DATE: _____

MEETING HELD BY: _____ (Field Supervisor)

PERSONS ATTENDING: _____

HAZARDS NOTED & DISCUSSED: _____

☐ Slip, Trip Fall; _____

☐ Personal Protective Equipment; _____

☐ Public Safety Protection; _____

☐ Hazardous Materials; _____

☐ Emergency Action Plan; _____

ATTENDEES SIGNATURES: _____

CONSULTING ENGINEERS

21 West Fourth Street, Eureka, CA 95501
TEL 707.443.5054
FAX 707.443.0553

PROJECT NAME:
PROJECT NO.:
DATE:
DRILLER:
PM:
LOGGED BY:

GLOBAL ID:
FIELD POINT NAME:
DRILLING METHOD:
AUGER/ROD DIAMETER (in):
LOCATION:
ELEVATION (ft):

LOCATION MAP

DEPTH (ft)	COLOR (MUNSELL)	SILT AND CLAY: %CLAY	SILT AND CLAY: %SILT	SILT AND CLAY: PLASTICITY N=NONE L=LOW M=MEDIUM H=HIGH	SILT AND CLAY: CONSISTENCY S=SOFT F=FIRM ST=STIFF H=HARD	SAND AND GRAVEL: %SAND F=FINE M=MEDIUM C=COARSE	SAND AND GRAVEL: %GRAVEL F=FINE M=MEDIUM C=COARSE	SAND AND GRAVEL: SHAPE/ANGULARITY	DENSITY L=LOOSE MD=MEDIUM DENSE D=DENSE VD=VERY DENSE	ASTM D-2488 GROUP SYMBOL	MOISTURE D=DRY M=MOIST W=WET S=SATURATED	% ORGANICS	ODOR	PID (ppm)	SAMPLE A=AUGER SS=SPLIT-SPOON CC=CONTINUOUS CORE PT=PUSH TUBE	OTHER REMARKS
				N L M H	S F ST H	F M C	F M C		L MD D VD	GW GP GM GC SW SP SM SC ML CL OL MH CH OH PT	D M W S				A SS CC PT	
				N L M H	S F ST H	F M C	F M C		L MD D VD	GW GP GM GC SW SP SM SC ML CL OL MH CH OH PT	D M W S				A SS CC PT	
				N L M H	S F ST H	F M C	F M C		L MD D VD	GW GP GM GC SW SP SM SC ML CL OL MH CH OH PT	D M W S				A SS CC PT	
				N L M H	S F ST H	F M C	F M C		L MD D VD	GW GP GM GC SW SP SM SC ML CL OL MH CH OH PT	D M W S				A SS CC PT	
				N L M H	S F ST H	F M C	F M C		L MD D VD	GW GP GM GC SW SP SM SC ML CL OL MH CH OH PT	D M W S				A SS CC PT	
				N L M H	S F ST H	F M C	F M C		L MD D VD	GW GP GM GC SW SP SM SC ML CL OL MH CH OH PT	D M W S				A SS CC PT	
				N L M H	S F ST H	F M C	F M C		L MD D VD	GW GP GM GC SW SP SM SC ML CL OL MH CH OH PT	D M W S				A SS CC PT	
				N L M H	S F ST H	F M C	F M C		L MD D VD	GW GP GM GC SW SP SM SC ML CL OL MH CH OH PT	D M W S				A SS CC PT	

DEPTH TO WATER (ft):
CASING TYPE/DIAMETER (in):
SCREEN INTERVAL (ft bgs):

PURGE VOLUME:
PURGE METHOD:

SAMPLING METHOD:
ANALYTES:
CLOSURE:

Attachment 3

NORTH COAST LABORATORIES LTD.
5680 West End Road • Arcata • CA 95521-9202
707-822-4649 Fax 707-822-6831

Chain of Custody

LABORATORY NUMBER:

Attention:
Results & Invoice to:
Address:
Phone:
Copies of Report to:
Sampler (Sign & Print):

TAT: ☐ 24 Hr ☐ 48 Hr ☐ 5 Day ☐ 5–7 Day
☐ STD (2–3 Wk) ☐ Other:
PRIOR AUTHORIZATION IS REQUIRED FOR RUSHES

REPORTING REQUIREMENTS: State Forms ☐
Preliminary: FAX ☐ Verbal ☐ By:__/__/__
Final Report: FAX ☐ Verbal ☐ By:__/__/__

CONTAINER CODES: 1—½ gal. pl; 2—250 ml pl; 3—500 ml pl; 4—1 L Nalgene; 5—250 ml BG; 6—500 ml BG; 7—1 L BG; 8—1 L cg; 9—40 ml VOA; 10—125 ml VOA; 11—4 oz glass jar; 12—8 oz glass jar; 13—brass tube; 14—other

PRESERVATIVE CODES: a—HNO_3; b—HCl; c—H_2SO_4; d—$Na_2S_2O_3$; e—NaOH; f—$C_2H_3O_2Cl$; g—other

PROJECT INFORMATION

Project Number:
Project Name:
Purchase Order Number:

LAB ID	SAMPLE ID	DATE	TIME	MATRIX*	CONTAINER/PRESERVATIVE	ANALYSIS

SAMPLE CONDITION/SPECIAL INSTRUCTIONS

RELINQUISHED BY (Sign & Print)	DATE/TIME	RECEIVED BY (Sign)	DATE/TIME

SAMPLE DISPOSAL
☐ NCL Disposal of Non-Contaminated
☐ Return ☐ Pickup

CHAIN OF CUSTODY SEALS Y/N/NA
SHIPPED VIA: UPS Air-Ex Fed-Ex Bus Hand

MATRIX: DW=Drinking Water; Eff=Effluent; Inf=Influent; SW=Surface Water; GW=Ground Water; S=Soil; O=Other.

ALL CONTAMINATED NON-AQUEOUS SAMPLES WILL BE RETURNED TO CLIENT

LACO ASSOCIATES
CONSULTING ENGINEERS

21 West Fourth Street, Eureka, CA 95501
TEL 707.443.5054
FAX 707.443.0553

Project Name: ____________________ Tech: ____________________

Mob/Demob time: ____________________

Project No.: ____________________ Travel time: ____________________

Date: ____________________ Time on site: ____________________

Global ID No.: ____________________ Time off site: ____________________

PM: Mileage:

WELL No. / DIAMETER (in) / TOTAL DEPTH (ft) / DEPTH TO WATER (ft)										
FIELD PARAMETERS	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL
pH										
TEMP (°C)										
[illegible]										
ORP (mV)										
DO (mg/L)										
OTHER (units)										
PURGE TIME										
METHOD (DHP/CB/B)										
RATE (gpm)										
VOLUME (gal)										
COLOR										
ODOR										
REMARKS										
SAMPLE TIME										
METHOD (DHP/CB/B)										
ANALYTES										
REMARKS										

DHP=DOWN HOLE PUMP CB=CHECK BALL B=BAILER FD=FIELD DUPLICATE MB=METHOD BLANK FF=FIELD FILTERED

REVISED [illegible]

Attachment 5

Attachment 2

HAZARDOUS WASTE SAFETY TRAINING AND MEDICAL MONITORING

Employees and subcontractors assigned to the project will have completed a 40-hour OSHA/EPA Hazardous Waste Site Investigation Health and Safety training course. Each employee and subcontractor will complete an annual 8-hour refresher course. Supervisors will have completed an additional supervisor's training course.

Each LACO employee performing work at the site will be responsible for complying with the procedures described in this Site Safety Plan and the LACO Illness and Injury Prevention Program. The Project Manager or Safety Officer may visit the site during the field investigation to evaluate the effectiveness of the program.

LACO personnel training and health surveillance data is listed below (verification is available at the company office):

Name	Potential Project Role	Init. OSHA Training	Ann. Refrsh. Training	Annual Medical/ Respirator Cert.
David N. Lindberg	Principal/CEG	11/08/90	03/04	05/05
David R. Gervan	Principal/PE	11/22/91	12/04	06/04
Frank R. Bickner	Principal/PG	11/08/90	12/04	05/05
Gary L. Manhart	Sr. Geologist/PG	11/10/95	12/04	05/05
Giovanni A Vadurro	Sr. Geologist/PG	07/02/99	03/05	05/05
Dale L. Romanini	Engineering Tech.	11/16/99	12/04	05/05
Christopher J. Watt	Sr. Geologist/PG	08/21/98	12/04	05/05
Timothy D. Nelson	Geologist/PG	03/07/97	12/04	05/05
Christine S. Manhart	Sr. Geologist/PG	04/13/01	12/04	05/05
Wilson J. Martinez	Engineering Aide	06/21/02	12/04	05/05
Jason P. Buck	Staff Geologist	11/20/02	12/04	05/05
Brian Nelson	Field Technician	06/13/03	12/04	05/05
Vincent T. Sullivan	Staff Engineer	02/09/04	-------	05/05
John M. Wellik	Staff Geologist	02/09/04	-------	05/05
Jamison Short	Field Technician	02/09/04	03/05	05/05
Dennis Lake	Driller	01/07/91	12/04	05/05
Steven Davis	Field Technician	02/15/05	-------	05/05
Mike Kitahara	Environmental Scientist	03/11/05	-------	05/05
Brian Hodgson	Staff Engineer	03/11/05	-------	05/05
Gwen Erickson	Staff Geologist	06/21/02	06/03	05/05
Caroline Levenda	Staff Geologist	04/10/03	03/04	03/05